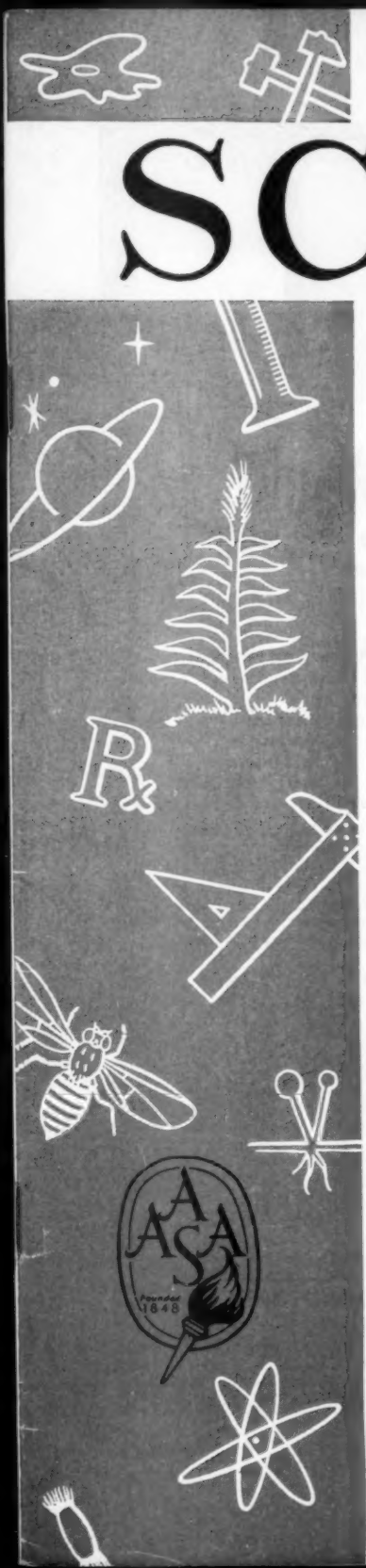

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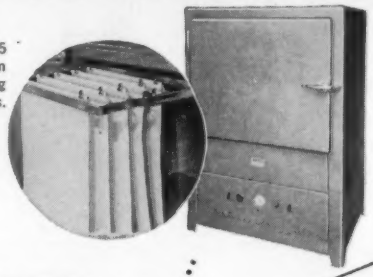

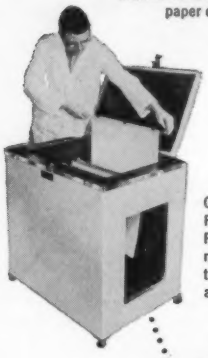

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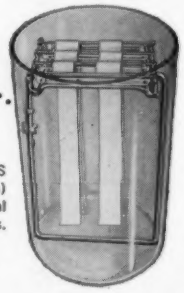

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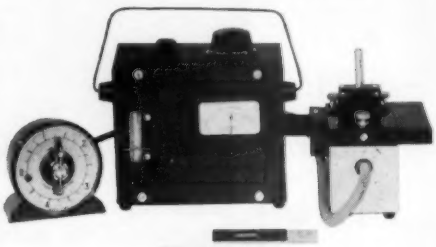

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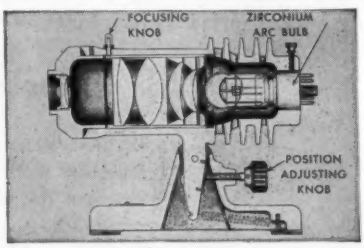

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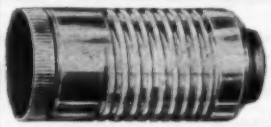

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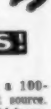

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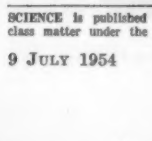

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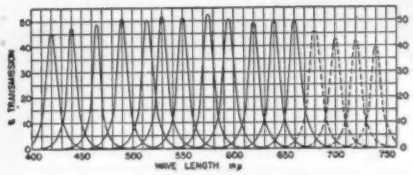

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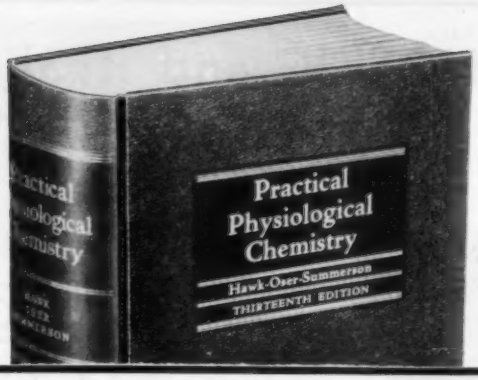

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AMERICA has yielded no remains of man comparable in age to such Old World finds as the Neanderthals of Europe, Pithecanthropus of Java, and the Australopithecines of South Africa. Despite the disadvantage of rarely being able to see fossil human bones, a few American anthropologists usually have an international reputation as students of ancient man. Their contributions, perforce, deal mostly with broad aspects of human evolution rather than with descriptions of actual specimens.

Until 5 years ago, American anthropologists inclined to this special interest were content to do little more than report developments and express opinions through established organizations of a general nature. The turning point came on 2 Sept. 1949 when six physical anthropologists attending a seminar at the Wenner-Gren Foundation for Anthropological Research in New York (formerly The Viking Fund, Inc.) informally constituted themselves and one other as the American Institute of Human Paleontology. The initial members were Joseph B. Birdsell, University of California at Los Angeles; Loren C. Eiseley, University of Pennsylvania (president); Paul Fejos, Wenner-Gren Foundation; Theodore D. McCown, University of California at Berkeley; Hallam L. Movius, Harvard University; T. D. Stewart, U.S. National Museum; Sherwood L. Washburn, University of Chicago.

The first, and so far most important, move of the Institute, aided by the Wenner-Gren Foundation, was to purchase the Barlow collection of molds in England and deposit it with the University Museum in Philadelphia. As a result of this and other acquisitions of molds, the University Museum is now supplying, promptly and at cost, reliable replicas of many remains of ancient man. Next, the Institute entertained at dinner in New York on 17 June 1952 all those attending the Wenner-Gren Foundation International Symposium on Anthropology. Henri V. Vallois, director of the Musée de l'Homme in Paris, gave the main address. Each guest received, as a souvenir of the occasion, two important casts from the Institute's collection of molds.

Activities on such a scale are not the sole purpose of the Institute. Each member strives in his own way to increase knowledge of ancient man. It is noteworthy in this connection that Movius joined with Vallois to edit the monumental *Catalogue des Hommes Fossiles* published by the XIXth International Geological Congress (1952). Two other members helped provide data for the catalog. This summer several members will visit the Old World to study original specimens.

In all such work, Americans often find it necessary to supplement the information appearing in print through correspondence or conversation with the original discoverers of early human remains. Casts and photographs of the objects, sometimes generously supplied by the discoverers, also convey some of the extra information. However, use of all such information raises ethical problems related to publication. Discoverers are accorded first publication rights, but when they delay publishing for many years the situation can become complicated. Thus, although the Institute is trying to speed the flow of information, at the same time it is intent on maintaining good working relations with foreign colleagues.

At the meeting of the Institute in New York on 15 May 1954, membership was increased to 16, a category of foreign corresponding membership was created, and Sherwood L. Washburn was elected president. Plans were made for expanding Institute activities, especially as regards research and fuller participation in forthcoming anthropological meetings. Since a need exists for roentgenographic standards in connection with fossil bones, a committee was set up to promote studies and publications along this line.

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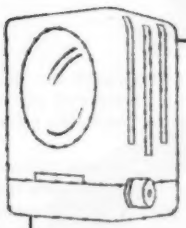

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Chelating Agents and Plant Nutrition*

L. H. Weinstein, W. R. Robbins, and H. F. Perkins

Rutgers University, New Jersey Agricultural Experiment Station, New Brunswick

A NUMBER of aminopolycarboxylic acids that form water-soluble metal chelates have come into use for correction of iron-deficiency chlorosis under field conditions. The best known of these materials is the iron salt of ethylenediaminetetraacetic acid (Fe-EDTA). It forms 5-atom, strain-free chelate rings, and there are 6 atoms, two of nitrogen and four of oxygen, that can donate electrons to metals. EDTA can grip an atom of iron with five chelate rings. Martell and Calvin (*1*) have recently published an extensive account of the chemistry of the metal chelate compounds.

Citric, malic, lactic, and tartaric acids and certain amino acids are naturally occurring chelating agents (*1*), but they are not as powerful as EDTA. If the root hairs of plants excrete chelating agents (*2*), this accounts for the way in which iron is made available from such slightly soluble compounds as ferric oxide or calcium from calcium carbonate. Chelating materials present in humus also aid in keeping iron available to plants (*3*). Therefore, many of these chelating materials (*3–5*), as well as the metaphosphates (*6*), have been used to keep iron available to plants under conditions of high phosphate, high *p*H, and under highly aerobic conditions in solution and in sand cultures.

Living organisms contain a number of chelate compounds that possess catalytic activity among which are hemoglobin, chlorophyll, the cytochromes, and the enzymes catalase, peroxidase, cytochrome oxidase, polyphenol oxidase, and ascorbic acid oxidase (*1*).

In selecting a chelating agent for use in plant nutrition, a number of factors should be taken into consideration. The most important of these are the stability constant of the metal chelate and the *p*H of the medium in which it is to be used. The higher the stability constant, the less tendency there is for the complex to dissociate and yield metal ions. The stability constant for the Fe^{+++} complex of EDTA is greater than that of EDTA chelates of other metal elements known to be essential in the nutrition of higher plants (*1*), and this holds true over a fairly wide *p*H range. The stability constant of Fe^{+++}-EDTA is followed in the order of decreasing values by those of the divalent cations Cu^{++}, Zn^{++}, Fe^{++}, Mn^{++}, Ca^{++}, and Mg^{++}. Therefore, it has been our experience (*7*) that soil applications of Mn-EDTA to manganese-deficient plants may result in a replacement of manganese in the chelate by iron in the soil.

Investigations by Jacobson (*8*) indicated that Fe-EDTA was a satisfactory nutrient source of iron for plants growing in solution culture. Work in our laboratory (*9*) has shown that Fe-EDTA is an excellent source of iron for sunflower plants growing in solution cultures adjusted to *p*H 7.0, a *p*H at which iron as ferrous sulfate is not readily utilized.

Because of the strong affinity of EDTA for iron, field applications of Fe-EDTA have been made primarily for the purpose of curing iron-deficiency chlorosis in acid soils. Stewart and Leonard (*10*) made some of the first applications for the control of iron-deficiency chlorosis of citrus. Successful applications have also been made to avocado (*11, 12*), azalea, gardenia, roses, corn, sweet gum, hydrangea (*11*), inkberry, pin oak, pieris, blueberry (*13*), banana (*14*), and many other plants. Use of Fe-EDTA on neutral or alkaline soils has met with little success, and new chelating agents, such as diethylenetriaminepentaacetic acid (DTPA), N-hydroxyethylethylenediaminetriacetic acid (HEEDTA), and N, N′-dihydroxyethylethylenediaminediacetic acid (HEEDDA), are being tested (*12, 15*).

Iron-deficiency chlorosis induced by accumulations of heavy metals is a serious problem in many parts of the world. Many soils of Florida are naturally low in iron, and the accumulation of heavy metals, especially of copper, is believed by Reuther and Smith (*16, 17*) to be the primary cause of iron chlorosis in citrus growing on certain acid soils. Westgate (*18*) suggests that a similar condition exists in old celery fields that have received heavy applications of copper sprays. He has successfully treated a copper-induced iron chlorosis in a variety of vegetable crops growing in these soils by applying physical mixes of $FeSO_4$ and Na_2EDTA. Smith and Specht (*19, 20*) obtained favorable responses from chelated iron when it was applied to citrus seedlings growing in solution cultures containing high concentrations of manganese, copper, and zinc. Solution-culture experiments in our laboratory (*9*) with sunflower plants have indicated that addition of 0.5 ppm of iron as Fe-EDTA to culture solutions containing 10.0 ppm of manganese as $MnSO_4$ resulted in excellent plant growth. Plants supplied with 0.5 ppm of iron as $FeSO_4$ and 10.0 ppm of manganese as $MnSO_4$ exhibited severe symptoms of iron-deficiency chlorosis (Fig. 1).

Because Fe-EDTA is very effective in correcting or preventing iron-deficiency chlorosis, the question naturally arises whether the chelator keeps the iron soluble

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Fig. 1. Sunflower plants growing in culture solutions supplied with 10.0 ppm of manganese as $MnSO_4$ and 0.5 ppm of iron as $FeSO_4$ (left) or Fe-EDTA (right).

until it can be absorbed by the plants, or whether the chelate actually enters the plant carrying the iron along with it to the leaves. Wallace and North (21) have concluded that EDTA is absorbed by plants by using Fe-EDTA that contained isotopically labeled nitrogen. Their conclusion that this complex was metabolized by plants was drawn from data obtained by analyses for isotopic nitrogen in various soluble and insoluble nitrogen fractions of corn leaf blade tissues.

In order to gain further information concerning the absorption and translocation of EDTA, sunflower plants have been grown in solution cultures with the divided or split-root system technique (*22*). The same basic nutrient solution adjusted to *p*H 7.0 was used in all treatments with the exception of $FeSO_4$ or EDTA as indicated. One-half of the root system of one treatment (Fig. 2) was grown with $FeSO_4$, whereas the other half of the root system was grown with Na_2EDTA. The roots with EDTA but with no iron developed mild symptoms of iron deficiency. However, the roots with $FeSO_4$ and without EDTA were white and well developed, and the leaves of these plants were green. For comparison, in another split-root culture, one-half of the root system received $FeSO_4$, whereas the other half received neither $FeSO_4$ nor Na_2EDTA. The roots in each half of this split-root culture were light brown, and the leaves were yellow. Both conditions are characteristic of iron deficiency in this species. The total fresh weight of plants in these cultures amounts to only 15 percent of the weight of plants from cultures supplied with EDTA.

It appears from this experiment that EDTA is absorbed by the roots of sunflowers and that iron is, in some way, made available to the plants. At *p*H 7.0, iron from $FeSO_4$ is absorbed, but after it enters the plant it apparently is not readily available for incorporation into iron enzymes. When EDTA was supplied through one portion of the root system, it apparently migrated to another part of the root system and to the top, chelating the iron and keeping it in a form available for metabolic use throughout the plant. Whether the iron chelate is transported without change to the leaves or whether the iron moves with some metabolized product of EDTA is not evident. It is possible that some of the iron may be released for enzyme use only after EDTA has been partially metabolized. Because of the high stability constant of Fe-EDTA, it would not be expected that this compound would readily give up its iron while still unchanged.

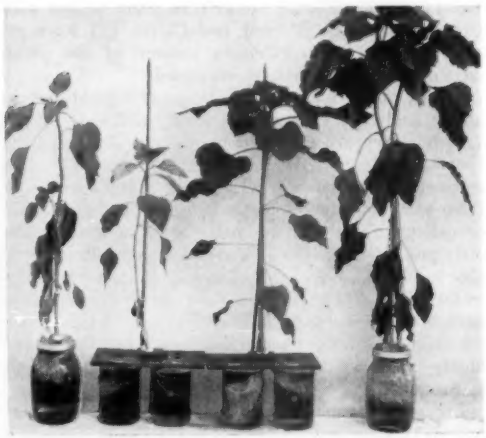

Fig. 2. Sunflower plants grown in split-root and complete-root solution cultures at *p*H 7.0 (Left) Supplied with 0.5 ppm of iron, no Na_2EDTA. (Left center) Left compartment supplied with 0.5 ppm of iron, right compartment with no iron and no Na_2EDTA. (Right center) Left compartment supplied with 0.5 ppm of iron, right compartment with 5.0 ppm of Na_2EDTA. (Right) Supplied with 0.5 ppm of iron and 5.0 ppm of Na_2EDTA.

Reports from a number of investigators have indicated that EDTA and its metal salts are toxic to plants in high concentrations. The physiology of this toxic effect has not been carefully studied. However, certain conclusions can be drawn from results of enzyme studies. Gross (*23*) has noted a stimulation of adenosine triphosphatase from mouse heart by use of low concentrations of EDTA, but a significant inhibition of activity resulted at higher concentrations. Swanson (*24*) reported a similar response with Mg^{++}-activated pyrophosphatase. Inhibition is presumably due to removal of enzyme-activating ions by EDTA. *In vitro* studies (*25*) at this station have shown a slight inhibition of polyphenol oxidase activity of sunflower leaf tissue but no inhibition of cytochrome oxidase and catalase. However, in studies with growing

plants, it was found that, with a nutrient level of 200 ppm of Na_2EDTA supplied to plants in nutrient solutions, the respiration rate of sunflower leaf tissue was only about 60 percent, the catalase activity was about 30 percent, and total fresh weight yield was about 54 percent of the respective values of leaf tissues from plants supplied with 5 ppm of Na_2EDTA. These results suggest that there is a competition between EDTA and the enzymes in the plant for metals essential for enzyme activity.

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Enzymatic Transfer of Alpha-Amino Groups*

Alton Meister

National Cancer Institute, National Institutes of Health, Bethesda, Maryland

THE first step in the metabolism of many amino acids in animals, plants, and microorganisms is separation of the α-amino group from the amino acid carbon chain, resulting in the formation of an α-keto acid. Reversal of this reaction—that is, conversion of a keto acid to an amino acid—is frequently the final step in the biosynthesis of an amino acid.

With the demonstration of enzymatic transamination by Braunstein and Kritsmann (*1*), it became apparent that intereonversion between certain amino and keto acids took place by an intermolecular transfer of an amino group from an amino acid to a keto acid by a mechanism not involving the intermediate participation of ammonia. Although the enzymatic transamination reaction was first described in 1937, it has been only recently that the extent and significance of amino group transfer reactions in the anabolism and catabolism of the amino acids has been recognized.

Several years ago, it was generally believed that three amino acids (alanine, aspartic acid, and glutamic acid) were the major, if nôt the sole participants in transamination (*2, 3*). However, the rapid incorporation of administered amino acid nitrogen into almost all the amino acids in animals (*4*) and the ability of the α-keto analogs of certain essential amino acids to substitute for these in supporting the growth of animals and microorganisms made highly probable the occurrence of reactions involving the exchange of amino groups of many other amino acids.

The major changes that have taken place in our understanding of the role of transamination in the biosythesis and degradation of the amino acids have been due to large measure to the development of new techniques of amino acid and keto acid preparation, identification, and quantitation. It now appears that virtually all the naturally occurring amino acids participate in transamination reactions, and that these reactions are catalyzed by a number of separate transaminase enzyme systems. Finally, as a result of recent work, the function of two phosphorylated derivatives of vitamin B_6, pyridoxal phosphate and pyridoxamine phosphate, as coenzymes for transaminase has become more firmly established.

This article considers some of the results obtained in the course of studies on transamination carried out in our laboratory (*5*). It was recognized at the start of these investigations that a comprehensive study would require pure preparations of the optical isomers and α-keto analogs of a wide variety of amino acids. The enzymatic methods of resolution of racemic amino acids developed by Greenstein and collaborators (*6*) have made possible the preparation of the D- and L-isomers of all the naturally occurring (and a number of other) amino acids in good yield and in a state of high optical purity (*7*). I was fortunate in being associated with some of these studies and to have been the recipient of generous amounts of these optically pure amino acids, which were essential for the present

* Paul-Lewis award address in enzyme chemistry, presented before the 125th national meeting of the American Chemical Society, 26 Mar. 1954, Kansas City, Mo.

work. At this time, only some of the α-keto analogs of the naturally occurring amino acids were known and could be prepared by methods described in the literature. It therefore became necessary to develop procedures for the preparation of other α-keto acids.

A general method was devised whereby amino acid isomers were oxidized by optically specific oxidases to the corresponding α-keto acids, which were purified by ion-exchange chromatography (or distillation), and crystallized as free acids or salts. In this manner, more than 30 α-keto acids have been prepared (*8, 9*) including those corresponding to arginine, citrulline, asparagine, glutamine, lysine, and ornithine. Through this work, preparation and study of the optical isomers of the α-keto analogs of isoleucine became possible. The adjacent positions of the carbonyl and asymmetric carbon atoms in this molecule provided a substrate advantageous for the consideration of certain aspects of enolization and α,β-unsaturation in transamination and other enzymatic reactions.

The present studies have revealed the function of glutamine and asparagine as amino group donors in transamination reactions leading to the formation of many of the naturally occurring amino acids. The α-keto acid-ω-amides corresponding to glutamine and asparagine are formed and hydrolyzed in the course of these reactions, which represent new pathways in the metabolism of these amino acid amides. The formation of asparagine from α-ketosuccinamate has been demonstrated, suggesting a possible pathway of asparagine biosynthesis.

Further evidence of the multiplicity of transaminase systems has come to light from investigations of a mutant bacterium in which the genetic modification is associated with loss of a transaminase specific for isoleucine and valine. Despite the wide scope of transamination, it is evident that each of the enzymes that catalyze these reactions possesses specific substrate requirements. For example, an enzyme fraction obtained from a bacterial organism catalyzes transamination only between glutamate, aspartate, phenylalanine, tyrosine, tryptophan, and their α-keto analogs, while another enzyme obtained from the same cell, catalyzes reactions only between valine and alanine or α-aminobutyric acid.

A relationship between vitamin B_6 and transamination was suggested and experimentally established in earlier studies, and this vitamin, in the form of pyridoxal phosphate, was considered to be the coenzyme for transaminase. Our investigations have been concerned in part with the role of the phosphorylated derivatives of vitamin B_6. Pyridoxamine phosphate, a form of vitamin B_6 known to occur naturally but previously found to be inactive as a coenzyme for transaminase, was shown by these studies to participate in transamination with α-keto acids to yield pyridoxal phosphate and the corresponding amino acids. Extension of these findings to other transamination systems led to the observation that the catalytic activity of pyridoxamine phosphate was equivalent to that of pyridoxal phosphate. The evidence is compatible with the concept that interconversion between enzyme-pyridoxamine phosphate and enzyme-pyridoxal phosphate complexes represents the basic mechanism of transamination.

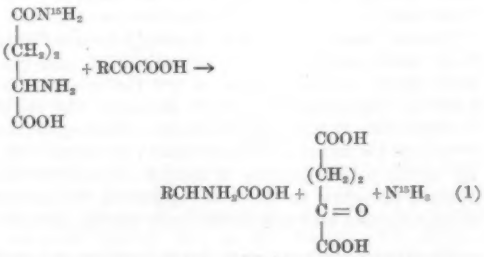
Role of Glutamine and Asparagine in Transamination

Asparagine was probably the first amino acid to be obtained from a natural source (*10*), while glutamine was first isolated 77 years later in 1883 (*11*). Both amino acid amides occur free in plant and animal tissues and also exist in peptide linkage (for example, proteins, insulin, oxytocin). The presence of considerable concentrations of these amides in the free state in animal and plant tissues suggests that they play a significant role in cellular metabolism.

The present studies on the function of glutamine and asparagine in transamination represent a logical development of earlier observations on the metabolism of glutamine and glutamic acid. In 1935, Krebs reported that preparations of various animal tissues catalyzed the deamidation of glutamine to glutamic acid and, under certain conditions, the synthesis of glutamine from glutamic acid (*12*). Study of the latter reaction has shown that adenosine triphosphate supplies the energy for glutamine synthesis (*13, 14*), and more recently the mechanism of this synthesis has been the subject of further investigation (*15*).

The deamidation of glutamine was studied in detail by Greenstein and collaborators (*16–19*), who discovered two hepatic enzymes which catalyzed this reaction. One of these required phosphate or certain other anions for activity, whereas the other enzyme deamidated glutamine only in the presence of an α-keto acid. Analogous reactions involving asparagine were also observed.

In 1950, we undertook a study of the α-keto acid-dependent enzymatic deamidation of glutamine, using a purified liver enzyme that had been isolated by Errera (*19*). The major results of this investigation may be summarized as follows: (i) When L-glutamine and an α-keto acid were incubated with the enzyme, there was stoichiometric formation of ammonia, amino acid, and α-ketoglutaric acid. (ii) With glutamine that was labeled in the amide group with isotopic nitrogen, all the isotope was recovered as ammonia, unequivocally establishing the amide group as the source of ammonia (*20*). Thus,



(iii) No ammonia was formed in the absence of an

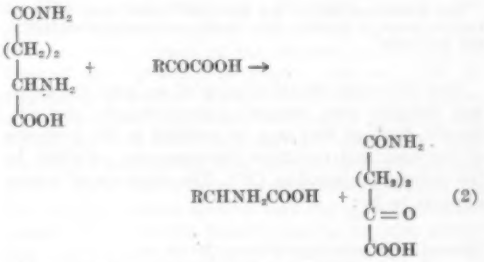
α-keto acid. (iv) With most of the α-keto acids studied, substitution of glutamine by glutamate resulted in a marked decrease or loss of transamination. (v) D-Glutamine was not active in this system.

These observations indicated that the deamidation and transamination phenomena were closely associated, and that deamidation did not precede transamination. It appeared possible that both reactions occurred simultaneously, or that transamination preceded deamidation. If the latter hypothesis were correct, it would be expected that α-ketoglutaramate would be formed as an intermediate, and that this α-keto acid-ω-amide would be either spontaneously or enzymatically deamidated to α-ketoglutarate.

In order to test this hypothesis, α-ketoglutaramate was prepared and studied in the enzyme system (*21*). Although α-ketoglutaramate was initially found to be only slowly deamidated by the enzyme preparation, it became apparent that this α-keto acid-ω-amide may exist in two interconvertible forms, only one of which exhibits properties characteristic of an α-keto acid. The α-keto analogs of glutamine and asparagine were prepared by enzymatic oxidation of L-glutamine and L-asparagine, respectively, by rattlesnake L-amino acid oxidase. In each case, the product obtained did not possess a reactive α-keto group as judged by ability to form a hydrazone and susceptibility to decarboxylation by hydrogen peroxide. Conversion of these products to forms that reacted readily with 2,4-dinitrophenylhydrazine and were decarboxylated by hydrogen peroxide occurred rapidly in alkaline solution. The reactive forms of α-ketosuccinamic and α-ketoglutaramic acids were enzymatically hydrolyzed by preparations of the glutamine transaminase and by a number of other tissue preparations. It was also of interest that the reactive form of α-ketosuccinamic acid, like many other α-keto acids (*22*), was reduced by lactic dehydrogenase in the presence of reduced diphosphopyridine nucleotide. Preparation and study of several related compounds (for example, α-ketoadipamic, α-keto-N-methylglutaramic, and α-keto-N-dimethylglutaramic acids) suggest that the ability to form such nonreactive structures depends upon a chain length of 4 or 5 carbon atoms and the presence of an ω-amide group in which at least 1 hydrogen atom is unsubstituted. The findings suggest a cyclic formulation for the structure of these compounds, proof of which must await further study.

The finding that α-ketoglutaramate was hydrolyzed by the enzyme preparation was compatible with the hypothesis that this keto acid was an intermediate in this reaction. However, attempts to isolate α-ketoglutaramate were not successful, because the activity of the amidase system was considerably greater than that of the transaminase, and also because of the relative instability of the latter system in the course of enzyme fractionation.

Another approach to the problem was therefore made in which a number of structural analogs of glutamine were studied in the hope of finding a substrate that would participate in transamination but whose α-keto analog would not be susceptible to attack by the amidase (*23*). These studies revealed the relatively strict specificity of the system for glutamine. For example, increasing or decreasing the length of the carbon chain (as in homoglutamine or asparagine) resulted in loss of activity. Substitution of the amide group in all but one instance yielded similar results. Of 22 compounds structurally related to glutamine, only three were active. One of these, γ-glutamylmethylamide, reacted with α-keto acids to yield the corresponding amino acid, α-ketoglutarate, and methylamine. On the other hand, two γ-substituted derivatives of glutamine, γ-methylglutamine and γ-methyleneglutamine (*24*), appeared to fulfill the desired requirements in that, although these amides transaminated with α-keto acids, no ammonia was formed in the course of the reaction. In the γ-methylglutamine-α-keto acid reaction, the formation of α-keto-γ-methylglutaramate was demonstrated, and a preparation of this keto acid, obtained by an independent procedure, was found to be insusceptible to the amidase activity. These results therefore suggest the following mechanism for the glutamine-α-keto acid reaction.



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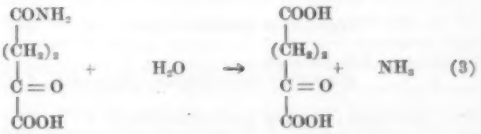


(3)

Although the γ-methylglutamine-α-keto acid reaction reached equilibrium at about 70 percent of maximal transamination, the glutamine-α-keto acid reaction proceeded to completion with stoichiometric formation of ammonia, a finding consistent with the expected tendency of the amidase system to force the reaction to completion by removal of α-ketoglutaramate.

The relatively narrow specificity for the amino group donor is in striking contrast to the large number of α-keto acids that are active as amino group acceptors (*20, 23, 25*). This is, therefore, a general transaminase system capable of catalyzing the formation of many of the natural amino acids. As is indicated in Table 1, almost all the keto acids studied were aminated. The failure of the keto analogs of isoleucine and valine to react suggests that the keto acid must have at least 2 β-hydrogen atoms in order to react,

and this conclusion is supported by the inactivity of trimethylpyruvate and α-ketophenylacetate. The α-keto analogs of lysine and ornithine may be insusceptible because of the tendency of these acids to cyclize to the corresponding piperidine and pyrroline derivatives (*26*).

Table 1. Amino acids formed by glutamine-α-keto acid transamination.

Alanine	Methionine
Glycine	Ethionine
Serine	Glutamic acid
α-Aminobutyric acid	Tryptophan
Norvaline	Asparagine
Norleucine	Cystine
Leucine	Arginine
Phenylalanine	Nitroarginine
Tyrosine	Cysteic acid
Cyclohexylalanine	Homoglutamine
α-Aminocaprylic acid	α-Aminoheptylic acid
ε-Hydroxy-α-aminocaproic acid	S-benzylcysteine
γ-Glutamyldimethylamide	ε-Carbobenzoxylysine
γ-Methylglutamine	δ-Carbobenzoxyornithine

The α-keto analogs of the following amino acids were inactive: valine, isoleucine, *tert.* leucine, α-phenylglycine, lysine, and ornithine.

In studies with the keto analog of arginine, the products included urea, glutamic-γ-semialdehyde, and glutamate, findings that may be ascribed to the presence of arginase and ornithine transaminase activities in the enzyme preparation (*27*). The sequence of events appears to be:

$$\text{Glutamine} + \alpha\text{-keta-}\delta\text{-guanidinovalerate} \rightarrow \text{arginine} + \alpha\text{-ketoglutarate} + \text{ammonia} \quad (4)$$

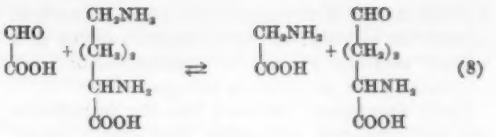
$$\text{Arginine} \rightarrow \text{ornithine} + \text{urea} \quad (5)$$

$$\text{Ornithine} + \alpha\text{-ketoglutarate} \rightarrow \text{glutamic-}\gamma\text{-semialdehyde} + \text{glutamate} \quad (6)$$

$$\text{SUM: Glutamine} + \alpha\text{-keto-}\delta\text{-guanidinovalerate} \rightarrow \text{urea} + \text{ammonia} + \text{glutamate} + \text{glutamic-}\gamma\text{-semialdehyde} \quad (7)$$

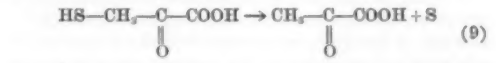
The reaction sequence could be stopped at reaction 5 by carrying out the experiments at *p*H 6, since reaction 6 does not occur at this value of *p*H. Furthermore, substitution of the keto analog of arginine with a nitro group in the amidine portion of the molecule resulted in the formation of nitroarginine, which accumulated and could be identified, since this derivative of arginine is not susceptible to attack by arginase.

The ornithine-α-ketoglutarate transamination reaction is atypical in that the δ-amino group reacts rather than the α-amino group. Nevertheless, ornithine also transaminated with other α-keto acids including pyruvic, α-ketobutyric, and glyoxylic acids, yielding glutamic-γ-semialdehyde, and the corresponding amino acids. The reaction between glyoxylate and ornithine is unique in that an aldehyde is both a reactant and a product:



(8)

An unusual finding that came to light in the course of studies on the α-keto acid specificity of the glutamine transaminase system was that alanine, rather than cysteine, was formed when β-mercaptopyruvic acid was incubated in the glutamine transaminase system. This result led to the finding of a new type of desulfuration reaction in which β-mercaptopyruvate was converted to pyruvate and sulfur (*28*):

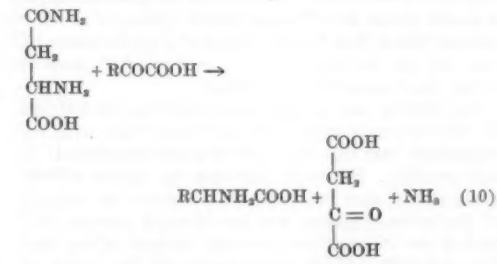


(9)

The enzyme that catalyzes this reaction is widely distributed and does not desulfurate cysteine or cystine. Transamination between β-mercaptopyruvate and glutamine to form cystine was demonstrated under conditions whereby appreciable desulfuration of the keto acid did not take place.

In contrast to cysteine desulfhydrase and glutamic-pyruvic transaminase activity, the glutamine-α-keto acid transaminase activity of rat liver was not significantly affected by vitamin-B_6 deficiency induced by dietary restriction of this vitamin and deoxypyridoxine administration (*29*). These findings do not necessarily exclude the participation of vitamin B_6 in the glutamine transaminase reaction, since the affinity of this enzyme for the coenzyme may be greater than that of the other systems studied. Further studies are necessary to elucidate this problem.

The existence of an asparagine-α-keto acid system, analogous to the glutamine-α-keto acid system, was suggested by the observation that the deamidation of asparagine was markedly increased in the presence of α-keto acids (*18*). Studies of this reaction revealed an associated transaminase reaction, whose specificity with respect to α-keto acids was similar to that of the glutamine system (*25*):



(10)

The asparagine-α-keto acid reaction appears to be catalyzed by a different enzyme than that responsible for the analogous reaction with glutamine, and in contrast to the latter system, the asparagine system was not found in kidney (*30*). Studies with the α-keto

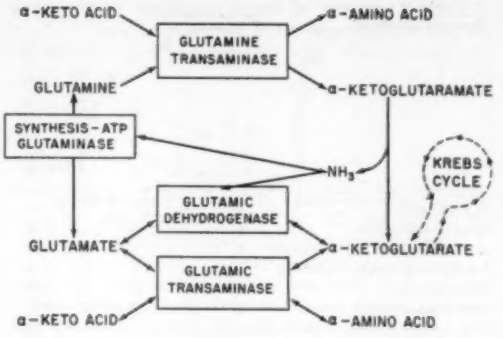


Fig. 1. Metabolic interrelationships involving glutamine.

analog of asparagine (α-ketosuccinamic acid) revealed that this compound was hydrolyzed to oxalacetate and ammonia by the enzyme preparation, a finding compatible with the participation of α-ketosuccinamic acid as an intermediate in the reaction (*21*). In the glutamine system, conversion of α-ketoglutaramate to glutamine could not be demonstrated, possibly because this amide was rapidly hydrolyzed to α-ketoglutarate and ammonia by this enzyme. Although α-ketosuccinamate was hydrolyzed by the asparagine transaminase preparation, it was possible, using high substrate concentrations, to exceed the capacity of the system to deamidate α-ketosuccinamate, and under these conditions, α-ketosuccinamate transaminated with a large number of L-amino acids to yield L-asparagine (*30*). D-Amino acids were not active in this system.

Some interrelationships between glutamine, asparagine, and their metabolites in liver are indicated in Figs. 1 and 2. The demonstration of the reversibility of α-ketosuccinamate formation raises the question of whether this keto acid may be a precursor in the biosynthesis of asparagine. The possibility that α-ketosuccinamate may be formed by a mechanism other than transamination remains to be investigated. Although glutamine is synthesized from glutamate, ammonium ion, and adenosine triphosphate, an analogous asparagine synthesis system has not yet been demonstrated.

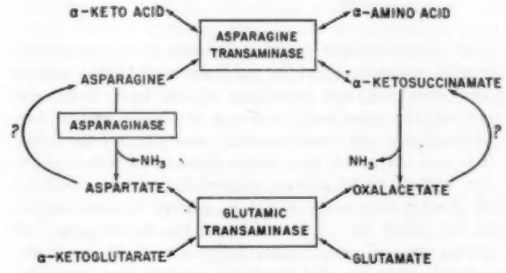


Fig. 2. Metabolic interrelationships involving asparagine.

Transamination Involving Isoleucine, Valine, Alanine, and α-Aminobutyric Acid

The demonstration of transamination reactions involving glutamine and asparagine, the participation of many α-keto acids in these reactions, and the finding in other laboratories of α-ketoglutarate-amino acid reactions (*31, 32*) suggested that the number of transaminases was considerably greater than was hitherto suspected. An interesting opportunity to examine the question of the multiplicity of transaminases arose as a result of the production of an unusual mutant strain of *Escherichia coli* by Bernard D. Davis. This organism required supplementation with L-isoleucine for growth, but in contrast to other isoleucineless mutants of *E. coli*, the growth of this mutant (No. 42-37) was not supported by the α-keto analog of L-isoleucine (*d*-α-keto-β-methylvalerate). A further point of interest was that supplementation with L-valine in addition to L-isoleucine was required for maximum growth, and here again the keto analog of valine (α-ketoisovalerate) did not serve in lieu of valine.

These growth phenomena suggested that the mutant organism lacked a transaminase capable of converting *d*-α-keto-β-methylvalerate to L-isoleucine, and this hypothesis was supported by the finding that cell suspensions and extracts of the mutant (in contrast to these of the wild strain of origin), were incapable of catalyzing reversible transamination between glutamate and α-keto-β-methylvalerate (*33*). However, although the enzymatic findings were compatible with the growth phenomena with respect to isoleucine, the results with valine were apparently contradictory. The enzyme studies showed that the mutant was incapable of reversible transamination between valine and α-ketoglutarate. However, although the growth studies revealed augmentation of growth in the presence of valine, considerable growth occurred in the absence of added valine. It therefore appeared that either valine was synthesized by a route not involving transamination, or that the organism possessed another enzyme capable of catalyzing transamination with valine. Examination of a large number of possible amino group donors revealed that only L-alanine and L-α-aminobutyrate were capable of reversible transamination with α-ketoisovalerate with extracts of the mutant strain, whereas this keto acid transaminated readily with these as well as with a number of other amino acids with preparations of the wild strain.

The evidence therefore indicated that at least three transaminase systems existed in the wild strain of *E. coli*: (i) an enzyme catalyzing transamination between glutaminate, isoleucine, valine, and several other aliphatic amino acids; (ii) a system catalyzing reactions between glutamate, aspartate, tryptophan, tyrosine, and phenylalanine; and (iii) a valine-alanine (or α-aminobutyric acid) system. The failure of the mutant to exhibit an absolute requirement for valine may be ascribed to the presence of the valine-alanine system. Confirmation of these results was obtained by physical separation of the three enzymes from extracts of the wild strain and by the finding that the valine re-

quirement of the mutant could be replaced by supplementation with equivalent amounts of either L-alanine or L-α-aminobutyric acid. Transamination pathways for the biosynthesis of isoleucine and valine in *E. coli*, consistent with the gene-enzyme concept, may therefore be formulated (Fig. 3).

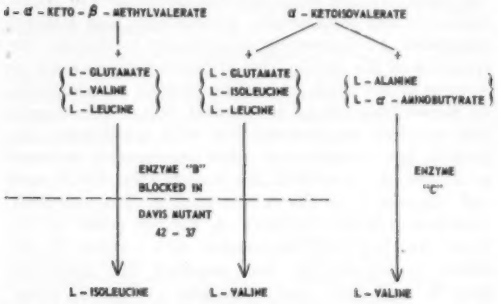


Fig. 3. Biosynthesis of isoleucine and valine by transamination.

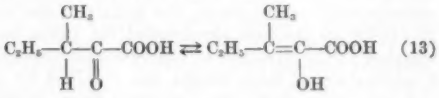
In the studies on the isoleucineless *E. coli* mutant (42–37) it became apparent that, of the four stereoisomers of isoleucine, only L-isoleucine was effective in promoting growth (Table 2). With other isoleucineless mutants of *E. coli* and with *Streptococcus faecalis*, L-isoleucine or *d*-α-keto-β-methylvalerate were capable of supporting growth, while the other three isomers of isoleucine and *l*-α-keto-β-methylvalerate were inactive. The strict stereospecific requirements of these organisms were in marked contrast to the behavior of *Lactobacillus arabinosus*, which responded to L-isoleucine, L-alloisoleucine, and both *d*- and *l*-α-keto-β-methylvalerate.

A study of enzymatic transamination with L-alloisoleucine and L-isoleucine, and the corresponding α-keto acid *isomers*, with preparations of *L. arabinosus* and of a hog heart preparation, revealed that the configuration of the β-carbon atom was not altered during the transamination reactions (*34, 35*):

L-Isoleucine + α-ketoglutarate ⟶
L-glutamate + *d*-α-keto-β-methylvalerate (11)

L-Alloisoleucine + α-ketoglutarate ⟶
L-glutamate + *l*-α-keto-β-methylvalerate (12)

On the other hand, it is clear that *L. arabinosus* possesses a mechanism for inversion of the β-carbon atom of L-alloisoleucine, since hydrolysates of organisms grown on L-alloisoleucine contain only L-isoleucine. Where the center of optical asymmetry resides at a carbon atom adjacent to a carbonyl group, enolization must result in racemization:



(13)

The rate of racemization of optically active α-keto-β-methylvaleric acid was found to increase rapidly with increasing alkalinity (*36*). The nature of the biological reaction is not known; formation of a phosphoenol derivative of the keto acid may be involved.

Table 2. Growth of several organisms on the stereoisomers and keto analogs of isoleucine.

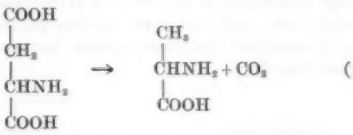
	E. coli (42–37)	*E. coli* (97–21)	*S. faecalis*	*L. arabinosus*	Rat
L-Isoleucine	+	+	+	+	+
L-Alloisoleucine	0	0	0	+	0
d-α-Keto-β-methylvalerate	0	+	+	+	+
l-α-Keto-β-methylvalerate	0	0	0	+	+
D-Isoleucine	0	0	0	0	0
D-Alloisoleucine	0	0	0	0	0

+ = growth ; 0 = no growth.

An inversion mechanism for *l*-α-keto-β-methylvalerate probably also exists in other species. Both isomers of α-keto-β-methylvalerate were found to support growth of weanling rats on an isoleucine-deficient ration, although the *l*-isomer was less effective than its *d*-enantiomorph (*37*). It is known that, of the four isomers of isoleucine, only L-isoleucine supports the growth of rats (*38*).

Relationship of Phosphorylated Derivatives of Vitamin B_6 to Transamination

The role of vitamin B_6 in enzymatic transamination was first suggested by Snell (*39*), and subsequent investigations have supported the concept that a phosphorylated derivative of vitamin B_6 functions as a coenzyme in transamination. Our initial studies involving pyridoxamine phosphate were carried out using a decarboxylase system of *Clostridium welchii*, which catalyzed the β-decarboxylation of L-aspartate to L-alanine (*40*).



(14)

This decarboxylase reaction proved to be unique in several respects. First, in contrast to the other amino acid decarboxylase reactions which have been described, the α-carboxyl was not attacked; second, the product was an α-amino acid; and finally, the reaction was activated by a large number of α-keto acids (as well as by pyridoxal phosphate). The activating effect of α-keto acids, although similar in some degree to the effect of α-keto acids on the deamidation of glutamine and asparagine, differed in one significant respect—that is, that catalytic, rather than stoichiometric, amounts of α-keto acids were required. Trans-

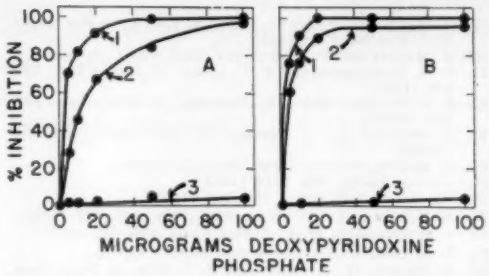


Fig. 4. Competition between coenzyme and deoxypyridoxine phosphate for the transaminase. *Curves 1*: Deoxypyridoxine phosphate was incubated with enzyme prior to addition of coenzyme. *Curves 2*: Deoxypyridoxine phosphate and coenzyme were added simultaneously. *Curves 3*: Enzyme was incubated with coenzyme prior to addition of deoxypyridoxine phosphate. A-pyridoxal phosphate; B-pyridoxamine phosphate. Experimental details are given elsewhere (*40*).

amination between the added α-keto acid and aspartate could be excluded from consideration, since alanine was the only amino acid formed, and because experiments with pyruvate labeled with radioactive carbon showed no incorporation of isotope into the alanine. A study of the activation of this decarboxylase system revealed that, after ultraviolet irradiation of the enzyme preparation, pyridoxal phosphate, but not α-keto acids, produced activation. Furthermore, such preparations were activated by pyridoxamine phosphate, provided that an α-keto acid was also present. These results suggested that the activating effect of α-keto acids on the decarboxylase system might be due to formation of pyridoxal phosphate by transamination between pyridoxamine phosphate present in the enzyme preparation and the added α-keto acid. Although further studies on purification of this enzyme are necessary in order to unequivocally prove this attractive hypothesis, these studies suggest the existence of an inactive enzyme-pyridoxamine phosphate complex, which may be converted by transamination with α-keto acids to an active enzyme-pyridoxal phosphate complex.

Although pyridoxal phosphate appears to represent an active coenzyme form of vitamin B_6 for decarboxylase activity and also for a number of other enzymatic reactions involving amino acids, it now appears that both pyridoxal and pyridoxamine phosphates are coenzymes for transaminase. Earlier studies in which pyridoxamine phosphate was found to be inactive may now be explained by the finding that combination of the enzyme with pyridoxamine phosphate takes place at a slower rate than enzyme-pyridoxal phosphate combination (*41*).

Preparation of crystalline pyridoxal phosphate, pyridoxamine phosphate, pyridoxine phosphate, and deoxypyridoxine phosphate (*42*), by Peterson and Sober (*43*) in this laboratory, made possible investigations on the coenzyme requirements of the purified pig heart glutamic-aspartic apotransaminase and on the mechanism of action of the inhibitor, deoxypyridoxine phosphate. As is indicated by the experiment described in Fig. 4, when the enzyme was incubated with either pyridoxamine phosphate or pyridoxal phosphate prior to addition of deoxypyridoxine phosphate, there was no inhibition. On the other hand, when incubation of the enzyme with deoxypyridoxine phosphate preceded addition of coenzyme, there was considerable inhibition. Similar results were observed with pyridoxine phosphate. The action of deoxypyridoxine phosphate (as well as pyridoxine phosphate), may therefore be ascribed to competition with the coenzyme for the enzyme. This type of inhibition, similar to that observed with the tyrosine decarboxylase system of *S. faecalis* (*44*), may explain, at least in part, the observed antagonism of vitamin B_6 by deoxypyridoxine in animals and microorganisms. Although deoxypyridoxine phosphate and pyridoxine phosphate can apparently combine with the enzyme, perhaps in part by linkages involving the phosphate group, these derivatives cannot participate in transamination.

The experimental findings with the phosphorylated vitamin B_6 derivatives are compatible with the following formulation, similar in principle to the original hypothesis of Snell, in which both pyridoxal phosphate and pyridoxamine phosphate function as coenzymes (*45*).

$$\text{Pyridoxal phosphate (or pyridoxamine phosphate)} + \text{enzyme} \longrightarrow \text{enzyme-pyridoxal phosphate (or enzyme-pyridoxamine phosphate)} \quad (15)$$

$$\text{Enzyme-pyridoxamine phosphate} + \alpha\text{-ketoglutarate (or oxalacetate)} \rightleftarrows \text{enzyme-pyridoxal phosphate} + \text{glutamate (or aspartate)} \quad (16)$$

It may be assumed that the rapid development of new knowledge of amino group transfer reactions during the last 3 or 4 years will continue for some time. Many of the tools and methods necessary for such further research are now available. It is clear from the wide scope of the transamination reaction that studies involving many amino donors and acceptors, as well as separation and purification of the catalytic systems involved, are minimal requirements for complete understanding of these metabolic phenomena.

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Analysis of Uranium in Sea Water

D. C. Stewart and W. C. Bentley

Argonne National Laboratory, Lemont, Illinois

To date, all the reported analyses of uranium in sea water have been based on the methods of Hernegger and Karlik (*1*). Uranium concentration (required because it is present in sea water only to the extent of a few parts in 10^9) has been accomplished by an elaborate series of coprecipitations with ferric hydroxide, and the final estimation has been carried out by use of the fluorophotometer. Sample sizes ranging from 200 ml to 22 lit in volume have been required.

In the present work (*2*), concentration has been accomplished by extracting the uranium directly from the sea water into an organic solvent containing dibutyl-orthophosphoric acid (DBP) as prepared by the method of Stewart and Crandall (*3*). Uranium estimation has been by fission-fragment counting of the U^{235} present by placing the sample in the Argonne heavy-water reactor. Routine sample sizes of volume 20 ml can readily be used, and, with special precautions, it should be possible to analyze accurately volumes of 1 ml or less.

The uranium is extracted by mixing the sample with 0.5 ml of 0.7–0.8*M* dibutyl-phosphoric acid in CCl_4. This is transferred *in toto* to a platinum counting plate, as is a subsequent "wash" of the same volume of CCl_4. After bringing the material to dryness and heating the plate in a flame, the sample is ready for counting. Standard plates carrying known amounts of uranium are counted at the same time, as are blank plates prepared directly from the reagents.

A preliminary test of the method was made, utilizing artificial sea water having the composition listed by Sverdrup, Johnson, and Fleming (*4*), ignoring components present to less than 0.01 percent; U^{233} tracer was added to produce 616 alpha counts per minute, per 50-ml sample. Six such samples were treated in this way to concentrate the uranium, but, in this case, the plates were alpha-ray counted rather than being put in the fission-fragment counter. The average recovery for the six samples was 94.5 percent ($s = 1.8$ percent).

Table 1. Recovery of added uranium from acidified natural sea water.

Sample	U (μg/lit)	
	Expected	Found
Unfortified 1953 Pacific Ocean water		2.36
		2.44
		2.43
		Mean = 2.41
Same + 0.33	2.74	2.82
	2.74	2.79
Same + 0.98	3.39	3.59
	3.39	3.53
Same + 1.77	4.18	4.18
	4.18	4.16
Same + 2.28	4.69	4.51
	4.69	4.55
Same + 3.26	5.67	5.60
	5.67	5.05

Table 2. Uranium content of some naturally occurring waters.

Sample	Size of sample	Acid added	Net fissions/min*	U (μg/lit)
1952 Pacific Ocean water	50 ml	None	8906	2.42
	50	None	9179	2.48
	50	0.44*M* HCl	8668	2.36
	25	.44*M* HCl	4902	2.60
1953 Pacific Ocean water	50	None	8854	2.40
	50	None	9268	2.52
	50	0.44*M* HCl	8780	2.39
	50	.44*M* HCl	9210	2.50
	25	.44*M* HCl	4740	2.58
	25	.44*M* HCl	4860	2.64
(Mean—all Pacific Ocean analyses)				2.49 ($s = \pm 0.09 = \pm 3.6\%$)
Great Salt Lake water	25	0.18*M* HCl	8960	4.79
	25	.18*M* HCl	9780	5.31
	25	.18*M* HCl	9150	4.97
Tap water	20	None	184	0.13
	20	None	157	.11
Distilled water	20	None	60	.04
	20	None	45	.03

* Corrected to allow for volume change where HCl was added.

A sample of natural Pacific Ocean coastal sea water was then acidified to 0.44*M* HCl and, after distributing the sample into a series of volumetric flasks, varying known amounts of natural uranium were added; 20-ml samples of these various solutions were then treated and assayed by fission-fragment counting. The results are given in Table 1.

The number of samples of natural salines available to us was very limited. Two samples had been taken in the surf on the Pacific Ocean side of the San Francisco Peninsula some 10 mo apart (1952 and 1953). One sample was collected in polystyrene bottles and stored in a Pyrex jar; the other sample was collected and stored in a soft glass jug. Neither sample was acidified until analysis. Great Salt Lake water was collected at the south shore and was acidified to 0.18*M* HCl when taken. Tap water and distilled water samples were taken at the Argonne National Laboratory, Lemont, Ill. The results on the uranium assays of these samples are given in Table 2. A uranium equivalence value of 71.8 fissions per minute, per millimicrogram of uranium was used, based on the average of counts taken on seven different plates made up from three different uranium stock solutions.

The Pacific Ocean assay figures given in Table 2 are higher than the majority of analyses of uranium reported by other investigators, but, since the samples were so few and since they were taken at the shore line, this may be of no significance. Hernegger and Karlik (*1*) originally reported values ranging from 0.87 to 2.15 μg/lit for samples taken near the west coast of Sweden and in the Skagerrak. Föyn *et al.* (*5*) found values ranging from about 0.5 to 1.8 μg/lit for samples taken from the same area and from the Adriatic Sea and the North Atlantic and North Pacific Oceans. Rona (*6*), using North Atlantic collected material, found lower and more erratic values. Koczy (*7*) had samples available from most of the oceans of the world and, on the basis of her results, concluded that the uranium concentration was quite constant, being of the order of 1.1 μg/lit at the surface and reaching a maximum of 1.4 μg/lit at a depth of about 1000 m. Nakanishi (*8*) reports values ranging from 1.75 to 3.37 μg/lit for samples collected from the Pacific Ocean near Japan. The exact value is of some interest, since, as Petterson (*9*) has pointed out in a recent review, it is still not possible to account for all the radium present in certain deep-sea sediments on the basis of the amounts of the parent uranium and ionium in the sediment plus the "potential" radium in the superimposed water column as calculated from the reported values for the uranium content of sea water.

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News and Notes

Engineering Education

Engineers should become more scientific, more creative, and more human. This evaluation of today's engineering education was the dominant theme of the 62nd annual meeting—largest in history—of the American Society for Engineering Education at the University of Illinois, 14–18 June. More than 1400 engineers, chiefly teachers from colleges in every state of the union and many foreign countries, registered for the meeting. They urged one another unanimously to devote more time to the basic sciences, engineering science, and the humanities—at the expense of engineering art and practice.

Industrial employers, agreeing with the educators, said that they were unwilling to have colleges sacrifice the sciences and humanities to provide time for studying technology or administration. They insisted that not only their research and development divisions but also their sales, manufacturing, and operating departments need engineers with strong scientific backgrounds. The extent of this move to strengthen science is obvious in an interim report of the A.S.E.E.'s Committee on Evaluation of Engineering Education released during the meeting. This proposal would have all engineering students—whether majoring in chemical, mechanical, electrical, civil, or other branches of the field—study in common almost five-sevenths of the total course. Only two-sevenths would be concentrated in the field of the major, and almost half of this would be as professional electives.

In his presidential address, Linton E. Grinter, dean of graduate studies at the University of Florida, said that colleges "must experiment with all possible methods of orienting engineering education more significantly toward basic and engineering science." The emphasis on science was continued by Lee A. DuBridge, president of the California Institute of Technology, who spoke at the celebration of the 50th anniversaries of the engineering experiment stations at the University of Illinois and at Iowa State College. "Maintain a close tie with the basic sciences," was DuBridge's advice. "An engineer, after all, is putting to practical use today what scientists discovered yesterday. . . . The main purpose of science is not to produce bombs and guns and radar—or even radios, refrigerators, and color television—but to advance human understanding."

Despite these high purposes of science, too few high-school students are being led to study it. Lenox R. Lohr, president of Chicago's Museum of Science and Industry, told the annual banquet of the Society that only 4 percent of his city's high-school students are studying physics and no more than 1.5 percent are studying solid geometry He commented that "Uninspired and inept instruction have too frequently made these all-important subjects a nightmare for the student"

This extensive discussion of the role of the basic sciences in engineering and engineering education was sparked by a year-long nation-wide study made possible by grants from the Engineers' Council for Professional Development, the Engineering Foundation, and the General Electric Co. These interim conclusions of the study were reported:

1) Mastery of a limited number of basic principles is far better than a superficial knowledge of expanded subject matter. Creative thinking, so essential in professional work, can result only after basic laws are mastered.

2) The training of engineers will have to take increasing notice of their position and influence in society and their recognized trend toward administrative and managerial positions.

3) The role of the engineer includes participation in research and development, plant operations, and engineering. To solve these technical problems requires the use of technology intimately mixed with economics and human relationships.

4) We shall have improved engineering education only when we have more good engineering teachers working in an environment in which they can function most effectively. Teaching ability should head the list of qualifications for appointments and promotions on engineering faculties.

5) Scientific advances force a new view of engineering education. The success of engineers in the last 10 yr has been due to the thoroughness with which fundamentals were taught. Predictions of atomic power and automatic control, for example, now indicate still broader activity, and the base of engineering education must therefore be further broadened. Only by increasing science in all curriculums can standards be raised.

Other highlights of the meeting included the following proposals and reports.

1) The demand from industry and government for new engineering talent continues to be greater than the current supply of graduates. Donald S. Bridgman of the American Telephone and Telegraph Co. reported a national survey showing that the decline in business activity and defense orders in 1954 has led to a 20-percent decrease in the need for engineers. But, he said, "with the relatively small classes graduating at this time, there is still substantial unfilled demand"

2) Eric A. Walker, dean of engineering at the Pennsylvania State University and chairman of the Engineering College Research Council, pointed out that "the colleges of engineering of the United States must be allowed to get into atomic research if they are to support and conduct a vigorous and up-to-date educational program preparing for careers in the general field of atomic energy."

3) Richard W. Schmelzer, assistant to the president at Rensselaer Polytechnic Institute and chairman of the A.S.E.E.'s Committee on Incentives for Good Teaching, proposed this formula for adding to the

stature of college teaching in America: "We need to create a climate of opinion so that the man who devotes himself primarily to teaching won't feel apologetic about it. . . ."

4) A special A.S.E.E. project to study the teaching of humanities and social sciences to engineers, financed by a $30,000 grant from the Carnegie Corporation, began work at a 2-day workshop session. The goal of the project, which is under the chairmanship of Edwin S. Burdell, president of Cooper Union, is to recommend ways by which engineering students' work in these liberal arts subjects may be strengthened.

5) A new plan to give foreign engineering students a chance to take summer jobs in American industry was discussed for the first time by F. M. Dawson of the State University of Iowa and Harold L. Hazen of the Massachusetts Institute of Technology.

RICHARD W. SCHMELZER
JOHN I. MATTILL
Rensselaer Polytechnic Institute, Troy, New York
Massachusetts Institute of Technology, Cambridge

Science News

When speaking in support of amendments to the **Atomic Energy Act** last month, Secretary of State John Foster Dulles pointed out that our formerly exclusive knowledge of atomic energy is now at an end and that "our potential enemies have a knowledge vastly superior to that of most of the nations which we count as friends." He called this "an unhealthy state of affairs," which means that "the present very strict secrecy requirements of the 1946 Act no longer represent the wisest international policy."

A bill, HR 9500, has been introduced in Congress to authorize the appropriation of $990,000 to enable the regents of the **Smithsonian Institution** to prepare detailed plans for a new museum building on Constitution Avenue and the Mall between 12th St. and 14th St. NW, in Washington. The structure will have an unusual scope, for it will be both a museum of United States history and of science, engineering, and industry. The project is described as a "history book" of objects in which all elements of national progress will be represented and related. Instead of the clutter of cases and machines of the old building, the visitor will find a central series of halls devoted to successive periods of history. In each hall the exhibits will relate to one period, illustrating its dominant character against the background of the living and thinking of its time and emphasizing the significance of the period in national development. These stories will be told with original documents, machines, costumes, weapons, inventions, home furnishings, the personal effects of famous Americans, and many other classes of objects from all sections of the Smithsonian. Beyond these central halls will be many others in which the details of the development of particular devices will be illustrated.

It is expected that the new plan will attract to the national collections many significant objects now owned by individuals and historical and professional groups. Leonard Carmichael, secretary of the Smithsonian, feels that the new building presents an opportunity for a fresh positive statement of this country's cultural, political, and industrial contributions to world progress.

An **electronically controlled force-reflecting manipulator,** considered to be the most advanced general purpose manipulative device thus far produced, has been constructed by engineers at Argonne National Laboratory. Developed by Raymond C. Goertz and W. M. Thompson of the Laboratory's Remote Control Engineering Division, the manipulator was displayed at the recent Nuclear Engineering Congress in Ann Arbor.

Used in conjunction with Argonne's three-dimensional television system, it enables investigators to perform complex laboratory and process manipulations at a distance of several hundred feet or from behind a sealed barrier with a speed and dexterity approaching that of the unaided hand. The device, which reproduces the seven basic motions that are employed in grasping, lifting, moving, and turning objects, has specially designed servomechanisms that reflect the work loads and resistances back to the operator.

The **University of Michigan's Fifth Aleutian Expedition,** left by boat for Kodiak, Alaska, on 20 June and from there flew to Unalaska, second largest island in the Aleutians, where headquarters were established. Theodore P. Bank, Jr., research assistant, is field director of the expedition and his wife is recorder. Other participants are Aloys C. Metty, assistant professor of dentistry; John F. Plummer, archeologist now completing his doctoral work in anthropology; Ralph L. Puchalski and James F. Scott, both graduate students who will be assistants to Dr. Metty; John S. Lowther, doctoral student in botany; and Jay E. Ransom, linguist from California.

The group will conduct dental and anthropological studies in a number of Bering Sea Eskimo villages. Surveys will be made of dental problems among the Southwest Alaskan Eskimos to determine the differences between Aleut, Eskimo, and Indian tooth patterns for the purpose of testing racial-genetic likenesses.

Archeological excavations will be made in two large prehistoric Eskimo mounds in the Eastern Aleutians and also at a newly discovered burial cave in Unalaska. The cave has been closed by rocks for hundreds of years and, by Aleut legend, it is taboo to enter. In addition, archeological surveys will be conducted on the tip of the Alaska peninsula to look for new sites to be explored in the future.

A highlight of the trip will be the ascent of 7000-ft Makushin Volcano on Unalaska, the first made by anyone. The crater area of this active volcano will be mapped and the adjacent glacier studied. The group also plans to make a full-length motion picture about the Bering Sea Eskimos.

Financial support is being provided by the univer-

sity's Botanical Gardens, the Wenner-Gren Foundation for Anthropological Research, the University of Oklahoma, and the newly formed Institute for Regional Exploration—a nonprofit organization devoted to furthering expeditions all over the world. Help in the field will come from the Alaska Native Service and territorial and federal agencies. Photographic aid has been furnished by the Argus Camera Co., Ann Arbor. The university conducted expeditions to the Aleutians in 1948 and 1949 under auspices of the Office of Naval Research, and in 1950 under the sponsorship of its Michigan Memorial-Phoenix Project. Twenty islands have been explored.

During the fall of 1952 members of the Virus and Rickettsial Study Section of the Division of Research Grants, National Institutes of Health, heard reports that infectious **ectromelia** was present in certain mouse colonies of the United States. With the knowledge that the presence of such an infectious agent constituted a threat to the progress of medical and other research, the Study Section named a committee consisting of Richard E. Shope, chairman, Karl F. Meyer, Frank L. Horsfall, Jr., W. T. S. Thorp, and Edward P. Offutt, executive secretary, to consider this situation and the problems it presented, and to make recommendations to the proper authorities.

The committee's first activity was to advise research grantees of the situation by individual notices sent to approximately 2000 persons widely scattered over the United States and in a few foreign countries. Cooperation in reporting suspected outbreaks and established infections was requested. To date, more than 1200 replies have been received, with a breakdown in the following simple fashion: no mouse stocks present, 746; no unexplained disease present, 440; unexplained disease (low mortality makes ectromelia less likely), 13; infectious ectromelia believed present, 18; infectious ectromelia proved present, 4.

In addition to reporting the results of its survey, the committee wishes to furnish additional information to research users and suppliers of the mouse. Therefore a 10-page mimeographed report has been prepared that describes the disease in detail and lists literature references on the subject.

Two **stone idols**, one male and one female, have been found near a grave in the ancient Indian Etowah mound near Cartersville, Ga. The 2-ft painted figures are seated and are carved in remarkable detail; they also are decorated with copper plates and wear headdresses. The find was made by an expedition sponsored by the Georgia Historical Commission in cooperation with State Park Service. Archeologist in charge is Lewis H. Larson, Jr., who is working under the direction of Arthur R. Kelley of the University of Georgia.

The figures resemble others excavated from the Etowah mounds in the 1920's by the late Warren K. Moorehead. Like those discovered previously, the newly found images suggest strongly a link between the Etowan people who made them and the Aztecs of Mexico and Yucatan. Certain prevailing feature's are apparent in both the Etowan and Aztec art, notably the posture of the seated figure. If the Aztec concepts of art were introduced in Georgia by migration from Mexico, it must have been at a very early date.

A different theory had been proposed by Dr. Moorehead, namely, that the Muskhogean culture of the Etowan people might have developed in our Southland and the migration might have been westward to Mexico instead of in the reverse direction.

In a statement issued to the press on 29 June, following the AEC 4-to-1 vote to refuse him security clearance, **J. Robert Oppenheimer** said:

> I have seen the release of the Atomic Energy Commission. Dr. Henry D. Smyth's fair and considered statement, made with full knowledge of the facts, says what needs to be said.
>
> Without commenting on the security system which has brought all this about, I do have a further word to say. Our country is fortunate in its scientists, in their high skill, and their devotion. I know that they will work faithfully to preserve and strengthen this country. I hope that the fruit of their work will be used with humanity, with wisdom and with courage. I know that their counsel when sought will be given honestly and freely. I hope that it will be heard.

A formal protest, describing the current **Selective Service policy toward scientists and engineers** as contrary to law and detrimental to the true national interest, has been filed with Major General Lewis B. Hershey, Selective Service director, by the American Chemical Society. The protest, in the form of a letter signed by Alden H. Emery, executive secretary of the society, criticizes the "apparent decreasing selectivity of Selective Service" and cites the handling of deferments for scientists, engineers, and other specialists as a disturbing case in point. Although the law is designed to enable each man to serve where he can contribute most to national health and security, Selective Service officials seem to be paying less and less attention to this question in weighing deferments. Mr. Emery wrote:

> We feel strongly that certain individuals . . . can make greater contributions to national safety and well-being in civilian assignments than in the military forces. It always has been our contention that the relative importance of these two assignments should be weighed in each individual case.
>
> It is the belief of our Board of Directors that this is not being done and, indeed, that local boards are being encouraged by you and your assistants to consider industrial deferments simply as a period for training replacements.

In support of the view that Selective Service is becoming less selective, Mr. Emery reported that the number of occupational deferments dropped from 32,439 to fewer than 21,000 during the past year and a half, although "needs have not decreased similarly." Deferments have dropped especially fast in recent months—2986 between 1 Dec. 1953 and 1 Mar. 1954. Mr. Emery stated further:

If this rate continues there will be no occupational deferments to grant after 1955. . . . [The current deferment] policies represent the decisions of a few individuals, not the requirements of the law. They are accepted because they are popular with those segments of the public which do not realize that there is more to military defense than discharging weapons. No military strategist would send men armed with crossbows against an army equipped with atomic artillery. We have weapons and protective devices today far superior to those as recently as 10 years ago because of the work of civilian scientists and engineers teamed at an appropriate stage with professional military personnel. Are we going to cut off further progress in that direction? Are we saying that we have gone as far forward as we need to?

Scientists in the News

The winners of the American Foundation for Pharmaceutical Education's Edwin Leigh Newcomb Memorial awards for original essays in the field of pharmacognosy have been announced. The graduate student prize went jointly to **Shafik I. Balbaa,** now assistant pharmacognosist at Fouad I University in Cairo, Egypt, and **Carl H. Johnson** of the College of Pharmacy, University of Florida, for their paper, "A pharmacognostical study of the origin of lemongrass oil." The undergraduate winner was **J. L. Renaud** of the School of Pharmacy, Medical College of South Carolina. Presentation of the awards will be made 20 Aug. during the 1954 meeting of the Plant Science Seminar at The University of Connecticut.

Betty Jane Bamforth has been appointed associate professor of anesthesiology in the University of Wisconsin Medical School.

In June, **Burr A. Beach** retired from the University of Wisconsin with the rank of emeritus professor of veterinary science. After earning his degree in veterinary medicine at Ohio State University in 1909, he joined the staff of the University of Minnesota. In 1911 he went to the University of Wisconsin as instructor in agricultural bacteriology; by the following summer he had switched to the department of veterinary science. In 1913 Dr. Beach was named assistant professor, in 1919 associate professor, and in 1936 full professor. From 1938 to 1945 he headed his department.

Dr. Beach was the first veterinary scientist in Wisconsin to produce hog cholera serum and to promote its use throughout the state; he was among the first to make and use a fowl pox vaccine; and he was instrumental in the development of the technique of the complement fixation test, forerunner of the blood test now used. With the late E. G. Hastings, he isolated the first culture of the organism producing Johne's disease, making possible the manufacture of Johnin to help control it. He also shared in the early work on brucellosis in dairy cattle, and on reactor problems in tuberculosis testing.

In his honor, the Wisconsin Veterinary Medical Association last year set up the Burr A. Beach award of $100 to be given annually to the university's outstanding graduate student in veterinary science.

Jule G. Charney of the Institute for Advanced Study was the Woods Hole Oceanographic Associates Lecturer for 1954. He delivered a series of six lectures in meteorology entitled "Scale and stability in planetary fluid motions."

Chester W. Clark, chemical engineer and a colonel in the U.S. Army Ordnance Corps, has been ordered to the Far East and will report to the West Coast Port of Embarkation early in July. Until he was promoted to deputy commander last June, Col. Clark had been chief of the research and development division at Picatinny Arsenal since 1951.

Jean A. Curran has been made associate executive dean for medical education in the State University of New York. Dr. Curran, who for 17 yr has been dean of the university's College of Medicine in Brooklyn and its predecessor, the Long Island College of Medicine, will assist Carlyle Jacobsen, executive dean, in matters relating to program planning for the health professions. This responsibility has been carried by Dr. Jacobsen alone since the university acquired its two colleges of medicine (Brooklyn and Syracuse) in 1950. Though Dr. Curran will leave the deanship as soon as his successor can be appointed, he will continue as professor of the history of medicine at the College of Medicine in Brooklyn.

Columbia University has announced that **Harry Linn Fisher,** president of the American Chemical Society, has been designated as Chandler lecturer and medalist for 1954. Selected for his outstanding contributions to the organic chemistry and technology of rubber, he will deliver the lecture and receive the medal on 10 Nov.

Norman E. Gabel, associate professor of anthropology at Santa Barbara College of the University of California, plans to spend his sabbatical leave in the Fiji Islands where he will investigate the racial make-up of the Melanesian natives. He will take photographs and also make detailed measurements of the physical characteristics of the people, augmented with blood analysis studies. The expedition is a continuation of the work done in 1947 by Edward Gifford, director of the Museum of Anthropology at the University of California, Berkeley.

Roger Gaudry, professor of chemistry at Laval University, Quebec, has been appointed assistant director of research for Ayerst, McKenna & Harrison, Ltd., Montreal.

Willis A. Gibbons, associate director of research and development at the United States Rubber Co., has retired after more than 41 yr of service with the company. A pioneer in the company's research program and its director from 1928 to 1946, his major developments have included latex dipping of tire cord, a new

test for vulcanization, a new method of vulcanization, and the manufacture of rubber thread and other products directly from latex.

The bronze medallion award of merit of the American Heart Association has been presented to **Lillian M. Gilbreth, Winthrop W. Aldrich,** and **Alton L. Blakeslee.** Dr. Gilbreth, an authority on time and motion studies, directed the creation of the New York Heart Association's "Heart Kitchen," the forerunner of the American Heart Association's national program of work simplification for the cardiac housewife. Mr. Aldrich, U.S. Ambassador to the Court of St. James, served as national campaign treasurer for the Heart Fund from 1949 to 1952. Alton L. Blakeslee, science reporter for the Associated Press, was honored for helping to develop greater public understanding of advances in the cardiovascular field.

Anthony J. Lanza, pioneer in the field of industrial medicine, is retiring at the end of this academic year and has been made professor emeritus of New York University–Bellevue Medical Center's Post-Graduate Medical School. A faculty member since 1947, Dr. Lanza has served as professor and chairman of the department of industrial medicine and director of the Center's Institute of Industrial Medicine. He will continue to act as a consultant and to lend his support to the development program of the Medical Center.

Since receiving his M.D. degree from George Washington University in 1906, Dr. Lanza has held important posts in the Government, as well as in private industry. While serving with the U.S. Public Health Service during and after World War I, he established 10 branches of the Office of Industrial Hygiene, and he served 2 yr each in the U.S. Coast Guard and in the Tuberculosis Sanatorium in Fort Stanton, N.M. For 5 yr he was chief surgeon in the U.S. Bureau of Mines.

In 1921 the International Health Board of the Rockefeller Foundation sent Dr. Lanza to Australia, where he established the division of industrial hygiene in the Federal Health Department of the Commonwealth Government and served as adviser until 1924. From 1926 to 1947 he was assistant, and then associate, medical director of the Metropolitan Life Insurance Co.

During World War II Dr. Lanza served as a colonel in the Medical Corps and was head of the Division of Industrial Medicine, Preventive Medical Service, in the office of the Surgeon General of the Army. At the close of the war, Dr. Lanza received the William S. Knudsen award for his contribution to the field of industrial medicine in the U.S. Army. He is an adviser in industrial medicine for a number of industrial organizations and is chairman emeritus of the American Medical Association's Council of Industrial Medicine.

Erwin F. Lowry of Sylvania Electric Products Inc., has been named to receive the 1954 gold medal of the Illuminating Engineering Society, highest honor in the field of illumination. Presentation will be made at the Society's annual National Technical Conference in Atlantic City, 13 Sept.

Dr. Lowry is the first physicist engaged in light source research chosen to receive the award. Nearly 30 patents have resulted from his researches, almost all of which are related to gaseous discharge devices, especially cathodes. Most of his contributions to lighting are incorporated in the development of the fluorescent lamp.

Robert E. Marshak, chairman of the University of Rochester physics department, who has been in Europe for the past year lecturing and studying under a Guggenheim fellowship, will return to his duties at the University on 1 Sept. He served as an exchange professor at the Sorbonne, where he gave 30 lectures on high energy physics, and as a consultant for the various theoretical groups at the Institut d'Henri Poincaré, Ecole Normale Supérieure, and French Atomic Energy Commission. He also gave lectures in Switzerland, Denmark, Italy, Sweden, Belgium, and England, and this summer will lecture at the French Summer School for Theoretical Physics at Les Ouches.

Harry Most, specialist in tropical medicine, has been appointed Hermann M. Biggs professor of preventive medicine and chairman of the department at New York University-Bellevue Medical Center's College of Medicine. He has been acting chairman since last July.

H. Necheles, head of the department of gastrointestinal research at Michael Reese Hospital, Chicago, will be a guest of honor at the Pan American Congress of Gastroenterology in São Paulo, Brazil, 19–24 July. Following the congress he will lecture at the medical schools of Montevideo, Santiago, Buenos Aires, and Lima.

Claude E. O'Neal, chairman of the department of botany at Ohio Wesleyan University and professor of botany on the Allen Trimble Foundation, is retiring after 41 yr of service. He holds the A.B., A.M., and Ph.D. degrees from Indiana University, is a past president of the Ohio Academy of Science, and has twice served as vice president of the Academy's botanical section. Former students, including several botanists of international reputation, paid tribute to his teaching and leadership at a retirement dinner at Ohio Wesleyan University on 6 June. **George W. Burns,** professor of botany, has been appointed chairman of the Department of Botany to succeed Dr. O'Neal.

Horace G. Richards, associate curator of geology and paleontology in the Academy of Natural Sciences of Philadelphia, has left for the Middle East and Africa. His purpose is a study of the ancient shore lines of the Mediterranean and the Red Sea. He is accompanied by his assistant, **James L. Ruhle.** They will visit Italy, Lebanon, Jordan, Egypt, Eritrea, Ethiopia, and French Somaliland.

Arthur Roberts, cosmic ray specialist and professor

of physics at the University of Rochester, has been given a year's leave of absence to serve with the U.S. Office of Naval Research in Europe as scientific liaison officer in nuclear physics. He will leave for London in August.

Royal W. Sorensen, professor of electrical engineering emeritus of the California Institute of Technology, has been elected to honorary membership in the American Institute of Electrical Engineers. Only two other living Americans are listed in the AIEE year book as having been so honored. They are former President Herbert Hoover and Vannevar Bush, president of the Carnegie Institution of Washington. Prof. Sorensen is the second Caltech staff member to receive the honor, the first having been the late Robert A. Millikan.

Meetings

The **American Institute of Homeopathy** will meet 18–22 July at the Grand Hotel, Mackinac Island, Mich.

An advance announcement of a **Conference on Nuclear Engineering** to be held at the University of California at Los Angeles, 27–29 Apr. 1955, and an invitation to submit papers to be read at the gathering, have been issued by the university's departments of engineering at Los Angeles and at Berkeley. The Conference, offered through University Extension and sponsored by the principal national engineering societies, will consist of three 1-day sessions, each devoted to one of the following topics: "Nuclear reactor power extraction systems and auxiliaries" (liquid metal systems, high-pressure water systems, etc.); "Nuclear system dynamics" (power system dynamic behavior, reactors, instrumentation, and control, etc.); and "Radiation sources for industrial applications."

Any person wishing to present a paper on one of these topics should send the title and an unclassified 200-word abstract to Prof. T. J. Connolly, Dept. of Engineering, University of California, Los Angeles 24, *before 25 July.* A description of the AEC-approved security-clearance procedure for papers will be mailed with notice of tentative acceptance of these proposed papers. Preprints of the papers finally selected will be available at the time of the conference.

An **International Congress of Anatomy** will be held in Paris, 25–30 July 1955. Prof. Gaston Cordier, 45, Rue des Saints-Pères, Paris (6e), is in charge of arrangements.

The **New York State Geological Association** held its 26th annual field meeting at Vassar College, 30 Apr.–1 May. It was attended by 165 individuals representing some 30 institutions and organizations from 7 states and Canada. Field excursions in the Hudson valley included study of the stratigraphy and sedimentation between Catskill and High Falls, and from Poughkeepsie to Hudson; metamorphism of sediments in Dutchess County; and the geology of the crystallines in the Hudson Highlands, Bear Mountain region. John G. Woodruff of Colgate University, where next year's meeting will be held, was elected president for 1954–1955. Kurt E. Lowe, City College of New York, continues as permanent secretary.

An international symposium on **"Problems in physiology and pathology of the eye"** will be held at the State University of Iowa College of Medicine, 24–25 Sept. The program will include: Gunnar von Bahr, Uppsala, Sweden, "Corneal thickness: its measurement and changes"; Giambattista Bietti, Parma, Italy, "Ophthalmic problems in diabetes and hypoglycemia"; Hans Goldmann, Berne, Switzerland, "Slit-lamp microscopy of the fundus"; Eugene Wolff, London, "Ophthalmic pathology of fat"; G. B. J. Keiner, Zwolle, Netherlands, "Optomotor reflexes"; H. K. Müller, Bonn, Germany, "Phosphate metabolism of the lens"; J. Boeck, Gras, Austria, "Periarteritis nodosa and related diseases"; Harold Henkes, Rotterdam, Netherlands, "Electroretinography."

Members of the **Southern Society of Cancer Cytology** wishing to present papers at the forthcoming annual meeting of the society are requested to apply to the program chairman, Dr. Lois I. Platt, George Washington University School of Medicine, 23rd St. at Washington Circle, Washington, D.C. This annual meeting is held conjointly with that of the Southern Medical Association, which this year will take place in St. Louis, 8–11 Nov. Address inquiries concerning the society to the secretary, Dr. J. Ernest Ayre, 1155 N.W. 14 St., Miami, Fla.

Society Elections

American Society of Biological Chemists: pres., C. G. King, The Nutrition Foundation; pres.-elect, J. Murray Luck, Stanford University; sec., Philip Handler, Duke University; treas., Philip P. Cohen, University of Wisconsin.

American Society for Engineering Education: pres., Nathan W. Dougherty, University of Tennessee; v. pres., Leo J. Lassalle, Louisiana State University; v. pres., Harold K. Work, New York University.

American Society for Pharmacology and Experimental Therapeutics: pres., Charles M. Gruber, Sr.; pres.-elect, E. R. Gross; treas., James M. Dille; sec., Carl C. Pfeiffer; representatives to the AAAS Council, Hamilton Anderson and R. H. Driesbach.

The Econometric Society: pres., Wassily Leontief, Harvard University; v. pres., Richard Stone, University of Cambridge; sec., Rosson L. Cardwell, University of Chicago; treas., Alfred Cowles, University of Chicago.

Iowa Academy of Science: pres., R. W. Getchell, Iowa State Teachers College; v. pres., U. A. Hauber, St. Ambrose College; sec.-treas., J. L. Laffoon, Iowa State College.

Mississippi Academy of Science: pres. C. L. Deevers,

Mississippi College, Clinton; pres.-elect, W. F. McCormick, M.S.C.W., Columbus; sec.-treas., Clyde Q. Sheely, Mississippi State College.

New Hampshire Academy of Science: pres. Tudor Richards, St. Paul's School, Concord; v. pres., W. M. Rayton, Dartmouth College; sec.-treas., Huntington Curtis, Thayer School, Hanover.

North Dakota Academy of Science: pres., G. A. Abbott, University of North Dakota; v. pres., Harry B. Hart, Jamestown College; sec.-treas., J. Donald Henderson, University of North Dakota.

Education

A **Committee on Army Medical Education** has been formed by the National Academy of Sciences–National Research Council, at the request of the Army Medical Service. Organized on 5 June, it replaces the former advisory committee of the Army Medical Service Graduate School, Walter Reed Army Medical Center. The new committee, instead of being limited to the scope of operations of the school, will deal with professional education and training problems of the Army Medical Service in its entirety and will act in an advisory capacity to the surgeon general. Three main functional areas in which the committee could be of service were outlined at the organizational meeting.

To determine, analyze and evaluate those professional and technical fields where civilian developments must be supplemented to meet the requirements of national defense.

To review the professional and technical programs in the Army Medical Service to determine whether or not they adequately meet the professional and technical needs for defense.

To review educational methods and career patterns being employed by the Army Medical Service so as to determine whether they are designed to produce the leadership and professional requirements for defense.

Membership of the committee includes: Dean A. Clark, Massachusetts General Hospital, chairman; Joseph M. Hayman, Jr., Tufts College Medical School; Franklin C. McLean, University of Chicago; John H. Mulholland, New York University; I. S. Ravdin, University of Pennsylvania; Grant Taylor, University of Texas; Gaylord W. Anderson, University of Minnesota; and Tom Bradley, National Research Council, executive secretary.

A study and planning group, supported by a National Science Foundation grant, will be at the University of Wisconsin from 21 June to 14 Aug. to consider the complex details of a proposed **cosmotron** to be located in the Midwest. This conference is part of an over-all project to establish a nonclassified research laboratory housing the cosmotron, which may cost up to 30 million dollars and is expected to produce energies in the neighborhood of 25×10^9 ev. No similar instrument has yet been built, although two such research projects have been authorized and designs are currently being completed. One of these cosmotrons will be located at Brookhaven, and the other will be built in Europe under the aegis of a group of European countries.

The project being discussed at Wisconsin is sponsored by the Midwestern Universities Research Association, an organization of institutions that have agreed to pool their resources and personnel for atomic research. Members are the Universities of Wisconsin, Minnesota, Illinois, Indiana, and Iowa State College.

Dedication exercises for Harvard University's new **Gordon McKay Laboratory of Applied Science** were held on 16 June.

Hamilton College and **Rensselaer Polytechnic Institute** have combined in a 5-yr plan to give engineers and scientists a broader base of cultural training than is available in the usual 4-yr courses. The students will take 3 yr of work at Hamilton and 2 yr at Rensselaer.

The seventh annual **Humble Lectures in Science** program at the Baytown, Tex., refinery of Humble Oil & Refining Co. will be concluded with a 2-wk course, beginning 16 Aug., in corrosion and electrochemistry to be presented by Norman Hackerman, chairman of the department of chemistry at the University of Texas.

At **Lehigh University** the cornerstone has been laid for a new seven-story engineering testing center. When completed in the summer of 1955, the new building will be 130 ft long, 70 ft wide, and 94 ft high. It will house a 5-million-lb capacity hydraulic tension-compression machine. This new machine will be 57 ft high and will be serviced by a 20-ton crane. Together with auxiliary apparatus, it will make possible a vast expansion in the services heretofore offered industry of the East Coast in proof testing their products.

Seven smaller laboratories in the new center will contain soils, sanitary, and materials testing equipment as well as facilities for photoelastic, model, instrument, and electronic work. There will also be a library, conference rooms, two seminar rooms, and 27 offices.

The first successful use of the **Massachusetts Institute of Technology's new "shock tube"** has been reported. Built and being operated under the direction of Raymond L. Bisplinghoff and H. Guyford Stever of the aeronautical engineering laboratories, it is actually a two-sided research tool that can be used to expose aircraft models to a high-speed shock wave comparable to that associated with a nuclear bomb, or as a short-duration wind tunnel to show the flow of air around an airplane at speeds up to 1.5 times that of sound.

The U.S. Atomic Energy Commission has approved the allocation of fissionable material as fuel for a nuclear reactor to be built by the **University of Michigan**. The "swimming pool" type reactor will be used

for the training of engineers and for research sponsored by the university and by industry. It will be part of the Michigan Memorial-Phoenix Project, which has been established with private endowments for studies of the peacetime implications and applications of atomic energy.

Grants, Fellowships, and Awards

Twenty-seven fellowships are offered by the **American Association of University Women** to American women for advanced study or research during the academic year 1955–56. In general, the $2000 fellowships are awarded to young women who have completed residence work for the Ph.D. degree or who have already received the degree; the $2500–$3500 awards are for more mature scholars who need a year of uninterrupted time for writing and research. Unless otherwise specified, the fellowships are unrestricted as to subject and place of study.

Applications and supporting materials must be submitted by 15 Dec. For detailed information, address the Secretary, Committee on Fellowship Awards, American Association of University Women, 1634 Eye St. NW, Washington 6, D.C.

This year the **American Heart Association** and its affiliates have jointly bestowed 169 awards totaling $953,370.71 on scientists engaged in research in the field of heart and blood vessel diseases. These awards represent an increase of approximately $150,000 over the sum allotted to research support last year. At the same time, the number of applications worthy of support increased by nearly two-thirds, with the result that promising projects had to be denied support for lack of funds.

Eli Lilly and Co. has approved a grant to support the fifth congress of the International Society of Hemotology that is to take place in Paris, 6–12 Sept. Other grants approved recently are as follows:

University of Illinois. L. M. Henderson, dept. of chemistry and chemical engineering. Antithyrotoxic factor.

Indiana University. R. C. Starr, dept. of botany. Establishment of a culture collection of algae.

University of Louisville. R. H. Wiley, dept. of chemistry. Triazoles and related compounds as pharmaceuticals.

Massachusetts General Hospital. J. H. Currens. Antihypertensive drugs.

University of Michigan. T. Francis, Jr., dept. of epidemiology. Fellowship for N. Ishida of the School of Medicine, Sednai, Japan, to work on viruses.

Northwestern University. C. J. Barborka, Medical School. Studies relative to "Elorine sulfate."

University of Oklahoma. S. H. Wender, dept. of chemistry. Flavonoid compounds.

University of Toronto. E. Baer, dept. of synthetic chemistry. Synthesis of lipopeptides.

Vanderbilt University. V. S. LeQuire, dept. of anatomy. Mechanisms controlling lipemia.

Wayne University. C. Djerassi, dept. of chemistry. Predoctorate fellowship in organic chemical research.

One-year clinical fellowships in the management of poliomyelitis are being offered for the first time by the **National Foundation for Infantile Paralysis.** Applicants must have completed at least 1 yr of internship in an approved hospital. Stipends will range from $300–$400 a month depending upon marital status and number of dependents.

The Foundation also has announced new fellowships in the field of orthopedic surgery for candidates under 36 yr of age. They are offered primarily for resident training at approved centers, and will be awarded for periods of 6 mo to 3 yr depending upon the time necessary for the candidate to be prepared for certification by the American Board of Orthopedic Surgery. Eligibility requirements include a 2-yr internship and 1 yr of resident training in general surgery at an approved hospital. The stipend will be $300–$400 a month.

One fellowship in orthopedic surgery will be offered each year to an applicant who has already completed 3 yr of approved resident training in the subject and wishes to study for a year at Georgia Warm Springs Foundation. The yearly stipend is from $4500 to $7000. Exceptions to the age of limit of 36 yr may be made for this candidate.

All applicants must make their own arrangements with the training center before applying for a fellowship. They must also be American citizens or applicants for citizenship. Applications received by 1 Sept. will be considered in November; those received by 1 Dec. will be considered in February; those submitted by 1 Mar. will be considered in May. For further information, address the National Foundation for Infantile Paralysis, Division of Professional Education, 120 Broadway, New York 5.

The **National Vitamin Foundation, Inc.,** has allocated $55,085.00 to support an extensive program of clinical and laboratory research in the fields of vitamins and nutrition. Eleven new grants have been awarded to universities and medical centers throughout the country.

St. Louis University. W. F. Alexander. Relation of vitamin B_{12} to nerve cell metabolism, $4000.

State University of Iowa. W. B. Bean and R. E. Hodges. Human pantothenic acid deficiency, $5000.

University of North Dakota. W. J. Bo. Processes involved in metaplasia in the rat uterus following vitamin A deficiency and the relationship between estrogen and vitamin A deficiency in producing metaplasia in the rat uterus, $3135.

Johns Hopkins University. B. F. Chow. Biochemical studies on the process of aging, $6000.

University of California. L. D. Greenberg and J. F. Rinehart. Fundamental biochemical and morphological pathology of vitamin B deficiencies in the Rhesus monkey, $7500.

University of Illinois. B. C. Johnson. Role of vitamin B_{12} in animal nutrition, $4950.

University of Illinois. R. M. Kark. Carnitine (vitamin B_T) levels in the blood, urine, and skeletal muscle of healthy individuals and of patients with nutritional disease, $3600.

Michigan State College. R. W. Luecke. Quantitative requirements of the baby pig for certain B vitamins, $3000.

University of California. M. M. Nelson. Multiple congenital abnormalities produced by maternal vitamin deficiencies, $3000.

University of Toronto. E. W. McHenry. Vitamin B_6 and intermediary metabolism, $2900.

New York University. E. P. Ralli. Influence of nutritional and hormonal factors in patients with diabetes mellitus, $12,000.

The **New York Tuberculosis and Health Association** has announced that its **Miller Fellowship** will be available from 1 July 1955 to 30 June 1956. This fellowship

is designed to support a qualified investigator in medical or biological science who will devote full time to a research project in tuberculosis or allied problems. Assurance must be given that the applicant will be acceptable in the laboratory or clinic of his choice and that he will be provided with the facilities necessary for the pursuit of the work.

The annual stipend will be $5000. Renewal for one or more years is possible. *Applications should be submitted in duplicate by 1 Nov.* Forms may be obtained from the New York Tuberculosis and Health Association, 386 Fourth Ave., New York 16. Awards will be announced 15 Dec.

The **Ohio State University Research Foundation** is administering 11 contracts totaling $334,615.86. All of the contracts but one are with various agencies of the Air Force, Army and Navy. The single project sponsored by industry is a $50,000 study in the department of chemistry for the American Petroleum Institute, New York, concerning synthesis of hydrocarbons.

The Wisconsin Alumni Research Foundation (WARF) has provided the **University of Wisconsin** with $860,340, the largest grant in the foundation's 29-year-old history. Conrad A. Elvehjem, dean of the Graduate School and chairman of the university research committee that has responsibility for administering the grant, said that the annual grant from WARF enables the university to keep a healthy balance in the source of research funds available to its scientists. Dr. Elvehjem commented that:

> At the present time, approximately 70 percent of all research in American academic institutions is supported by the federal government. Any imbalance in the source of support or in the use of research funds will eventually lead to difficulties. Financial freedom is as important as academic freedom in the field of research.

Miscellaneous

The Directory of New Zealand Science is an address book of New Zealand scientists and scientific institutions. Edition 3 (1954) contains approximately 1600 personal entries, the names of some 700 instructors in agriculture and teachers of science in post-primary schools, 100 scientific institutions, 50 scientific societies, 150 suppliers of scientific equipment, 400 overseas firms providing scientific equipment having local agents, and a complete list of New Zealand journals that publish original scientific material. To order, write The Directory Editor, Box 1874, Wellington, New Zealand.

To further international cooperation, the Science Council of Japan, in collaboration with the Education Ministry, has compiled a new publication entitled ***Japan Science Review—Medical Sciences.*** The first volume has more than 800 pages and contains a detailed bibliography of approximately 4500 papers in medicine, pharmacy, and dentistry published in Japan during 1953. Also included are 1100 abstracts, in English, of the more important works. These are prepared in accordance with the UNESCO directions for abstract writing and are printed on heavy paper so that each may be cut to make a card of standard size for filing convenience. Arrangement of the contents follows the Universal Decimal Classification system. This review may be obtained from a bookseller in Japan or directly from the publisher, Gihodo, 5, Akasada-Tameike, Minato-ku, Tokyo.

A call for **identical twins,** in which either or both members suffer from multiple sclerosis, has been made by the National Multiple Sclerosis Society in an effort to further research into the possible hereditary and environmental causes of the disease. Twins responding will be asked to cooperate in a scientific study of their lives and medical histories.

Because **microseisms** are the subject of intensive research in many areas of the world and also because the phenomena probably have a potential application other than storm detection, it was considered that a symposium on the subject would provide a worthwhile opportunity for active investigators from this country and abroad to bring together the existing observations in this field, appraise their significance, and consider problems for further study. Such a symposium was organized by R. C. Gibbs of the National Academy of Sciences—National Research Council and was held at Arden House, Harriman, N.Y., 4–6 Sept. 1952, under the sponsorship of the Office of the Naval Research and the geophysical research division of the U.S. Air Force. It was attended by some 30 specialists in the field.

The program was organized and directed by Perry Byerly of the University of California at Berkeley. James T. Wilson of the University of Michigan and Frank Press of the Lamont Geological Observatory edited the publication, *Symposium on Microseisms,* which incorporates the eight papers presented during the conference as well as the formal discussions and comments from the floor. The book, which contains 132 pages, some 100 illustrations and tables, and lists of literature references, may be obtained for $1.00 from the Publications Office, National Academy of Sciences—National Research Council, 2101 Constitution Ave., Washington 25, D.C.

Many of FAO's member countries are interested in increasing their reforestation (replanting or reseeding of forests) and afforestation (establishing new forests) programs. To meet this interest, FAO has set up a **Seed Exchange Clearing House** for forest tree seeds.

So far more than 100 government and private agencies have approved of the service and have indicated over 1000 species which they could supply on an exchange or commercial basis.

Copies of the lists of species and suppliers have been sent to forestry agencies and departments throughout the world. Additional copies are available from the North American Regional Office of FAO, Room 1529, 1325 C St. SW, Washington 25, D.C.

Book Reviews

Cell Chemistry. A collection of papers dedicated to Otto Warburg on the occasion of his 70th birthday. Dean Burk, Ed. Elsevier, Houston–Amsterdam, 1953. 362 pp. Illus. $7.50.

The original edition of this book appeared as an issue of *Biochimica et Biophysica Acta* (vol. 12, No. 1/2, 1953). It contains 35 original papers by recognized leaders in the field of biochemistry, including two papers in which Warburg himself is an author, thereby attesting to his continued vigor and productivity. This volume, covering a diversity of subjects, provides an illuminating cross section of the best in current biochemical thought. Although there was obviously some attempt on the part of the editor to select authors whose work has developed from fundamental observations made by Warburg during the past 50 years, this has in fact imposed no limitation on the selection process, since there is probably no worker in biochemistry today who has not profited in some way from one or more of Warburg's contributions. A chronological listing of the experimental contributions that are regarded by Warburg as his most important discoveries is provided by the editor in an unusual introduction, which includes some interesting comments on Warburg's personal, scientific, and political history.

The high caliber of the present volume is best indicated by the following impressive list of the principal authors: L. F. Leloir, H. Tamiya, J. H. Northrop, P. Karrer, F. F. Nord, C. B. van Niel, E. Boyland, V. Du Vigneaud, R. Wurmser, B. L. Horecker, J. H. Quastel, O. Meyerhof (deceased), A. Szent-Györgyi, C. Martius, F. Lipmann, H. H. Weber, A. L. Schade, H. A. Krebs, A. I. Virtanen, A. L. Lehninger, G. D. Greville, H. O. L. Fischer, H. G. Wood, A. Kornberg, G. T. Cori, E. S. G. Barron, H. M. Kalckar, C. Neuberg, H. Theorell, C. Fromageot, B. Chance, F. Lynen, S. Ochoa, D. Nachmansohn, R. Kuhn, D. Burk, and O. Warburg.

SIDNEY P. COLOWICK
McCollum-Pratt Institute, Johns Hopkins University

Signal, Noise and Resolution in Nuclear Counter Amplifiers. A. B. Gillespie. McGraw-Hill, New York; Pergamon Press, London, 1953. 155 pp. Illus. $4.50.

This short monograph presents an orderly and readily understood analysis of signal, noise, and resolution in equipment for electrically detecting, amplifying, and counting nuclear particles. The principal problem treated concerns pulses from a gas ionization chamber. Such pulses require considerable amplification and become mixed with noise arising from grid current and shot effect in the input stage. The author restricts his detailed treatment to an amplifier whose pass band is set by single RC time constants at low and high frequencies. Although the high-frequency cutoff of practical amplifiers is usually more rapid than that arising from a single RC element, favoring a higher signal-to-noise ratio, the essential factors involved are all carefully treated in the analysis and, in many cases, subjected to experimental verification.

The derivation of mathematical results is contained in an appendix where it does not obscure the main line of reasoning. At one point, the author admits that one of his mathematical findings disagrees with what one might expect on an intuitive basis, and a careful examination shows that his analysis is in error. Fortunately, he discards this result in favor of one that is essentially correct and from which he derives useful results that appear to agree with experiment. Except for this slight lapse in mathematical analysis, no other errors have been detected.

The monograph leaves no doubt in the mind of the reader that the author is very familiar with his subject. The ideas presented in the monograph should be understood by every experimentalist who uses electronic techniques for making nuclear measurements.

W. C. ELMORE
Department of Physics, Swarthmore College

A Bibliography of the Research in Tissue Culture: 1884 to 1950, Vols. I and II. An index to the literature of the living cell *in vitro*. Margaret R. Murray and Gertrude Kopech. Academic Press, New York, 1953. 1741 pp. $24 per set.

Workers in a particular field of investigation often drift along complacently for years preoccupied with immediate current tasks, only to awake abruptly to the realization that some single phase of activity has been so long neglected that a really herculean effort is needed to bring things back into balance.

The tissue-culture field has recently been pulling itself out of just such a shock. In Nov. 1946, at the invitation of the Committee on Growth of the National Research Council, a group of tissue culturists and others met at Hershey, Pa., to discuss mutual problems. When this group came to summarize its discussions, several tasks were recognized as urgently requiring attention. The Tissue Culture Commission was organized to implement this need. This commission later became the present Tissue Culture Association.

The tasks that the commission (association) set for itself were four: (i) To establish and maintain a training course for workers in tissue culture, until such time as some university would take over this work. This course was conducted for one summer at Toronto and then transferred to Cooperstown, N. Y., where it has become the well-known Cooperstown Course in Tissue Culture Techniques. (ii) To provide a source of tissue-culture nutrients and supplies available to all laboratories so as to free individual workers from the time-consuming and often complex problems

of supplying them individually. Microbiological Associates and Difco Laboratories have ably taken over this problem. (iii) To set up a testing laboratory that would establish standards of uniformity for all nutrient ingredients and certify the acceptability of commercial products. This project has met with many vicissitudes and has never been fully and satisfactorily consummated. (iv) To prepare a working bibliography of the entire field of tissue culture. This last task was assigned to Margaret R. Murray. The two volumes under review are the result of this assignment.

In setting up this project, the commission (association) recognized that the field was a broad and diverse one which had long been neglected in the usual review journals. But it did not quite realize the extent of this neglect. Not a single review of the subject in English had appeared since 1928. The *Annual Review of Physiology, Annual Review of Biochemistry,* and similar publications were blank on this point. So were *Biological Reviews, Physiological Reviews,* the *Quarterly Review of Biology,* and others, except for Bloom's rather limited and specialized paper (1939). The latest compendium was Fischer's *Gewebezüchtung,* which appeared in its last edition in 1930. This included a bibliography of about 3000 titles. It was hopefully estimated that perhaps 4000 new ones might be found. How wrong this figure was! Before the task was completed 29,000 articles in 27 languages were read and indexed. Endless time was spent in weeding out some 5500 "ghost" references—references that exist in the literature but in such defective form that the reviewers could not even identify any valid article to which they could be referred! Not only did the task grow but the concept of what was needed likewise grew. Dr. Murray enlisted the technical help of Gertrude Kopech, a young woman with sound bibliographic training, a record of experience in commercial bibliographic work which gave her a clear idea of what the working scientist needs, an unusual flair for languages which included command of a wide range of Slavic tongues as well as the Latin and Germanic ones, and a degree of dedicated thoroughness not often to be had.

The result after nearly 7 years of labor is a bibliography covering 66 years of the literature of a sprawling inchoate but highly important field, fully cross-referenced, and unusually usable.

It has its faults, of course. No work of 2000 pages of small type could possibly be free of them. The thoroughness of cross-indexing and the useful, but sometimes unnecessary, custom of citing every reference in full under each heading has sometimes resulted in the same title appearing two or three times on a single page. The user may appreciate this, but it does add to costs. There are lacunae. This reviewer failed to find any references to the effects of Pyrex or Jena versus soft glass on growth of cultures, which is certainly a surprising gap in the literature if it is a real one. Too close adherence to the *Union List of Periodicals* has resulted in a rather disconcerting mode of citation of what most of us know as the *Journal of the National Cancer Institute.* There are other lapses. But on the whole it is an extraordinary job for which the authors are to be congratulated.

It is fortunate that this task *has* been merely catching up on 25 years of neglect and will not have to be repeated in a year or so! It is to be hoped that 5- or 10-year supplements will make the job much lighter in the future.

These two volumes will be a "must" in every research biology library and on the desk of every investigator interested in the aseptic cultivation of plant and animal cells. We can only say, "Thank you, Dr. Murray and Miss Kopech, for a colossal and important job, well done!"

PHILIP R. WHITE
Roscoe B. Jackson Memorial Laboratory
Bar Harbor, Maine

Manuel de Paléontologie Animale. Léon Moret. Masson, Paris, ed. 3, 1953. 759 pp. Illus. Paper, 2880 fr.

In this third edition of a standard French paleontology textbook, a 12-page addendum, consisting for the most part of a list of significant publications, has been added. They are listed according to the pertinent chapters, together with some commentaries. Otherwise, the text is that of the 2nd edition of 1946.

JOEL W. HEDGPETH
Scripps Institution of Oceanography,
La Jolla, California

Electrostatique et Magnétostatique. Emile Durand. Masson, Paris, 1953, xii + 774 pp. Illus. Paper, 5760 fr., cloth, 6335 fr.

A theoretical book on this subject usually concentrates one one of the following topics: (i) general theory, based on Coulomb's and Ampère's laws; (ii) formal problem-solving techniques; (iii) properties of matter. This book presents all three topics in detail, at an advanced level—a stupendous undertaking but remarkably successful.

The second topic shows firsthand experience. Durand expertly presents a huge amount of useful material. He spends little time reviewing the elementary properties of complex variables or spherical harmonics, but he works out many problems in full. Conformal transformations and numerical methods get considerable attention.

For the third topic, the author seems to have compiled material mostly from secondary sources. He discusses all electromagnetically conditioned properties except those that are primarily quantum-mechanical or dynamic. His organization is skillful; and where he had a number of treatises and review articles to draw from, as in ferromagnetism, his selection is judicious. In dielectrics, books and reviews are scarce, and here his discussion is less balanced; he omits recent (1936–) statistical-mechanical calculations.

The handling of the first topic is faulty at a few points. On pages 62–63, the author forgets that the

field intensity, defined directly from Coulomb's law, converges only conditionally at points of the dipole distribution; he thus implies that some formulas express theorems when in fact they express arbitrary conventions. He follows tradition by localizing the energy; the method leads to no wrong results, but it encourages wrong interpretations of the results. Confusion about these things has loaded the literature with futile controversy. These are regrettable defects in an otherwise masterly presentation, which shows much originality.

Durand uses Giorgi meter-kilogram-second units; he has even translated all his magnetization curves from the original electromagnetic.

There are few specific references; data and figures are often quoted with no, or only vague, mention of the sources But if the reader wishes to follow up particular topics, he can ultimately find what he needs by consulting the general references that are listed at the ends of the chapters.

WILLIAM FULLER BROWN, JR.
Sun Physical Laboratory
Sun Oil Company, Newtown Square, Pennsylvania

The Furans. A.C.S. Monograph Series. A. P. Dunlop and F. N. Peters. Reinhold, New York, 1953. xix + 867 pp. Illus. + plates. $18.

It may be said that furan chemistry has had its ups and downs. Older than benzenoid chemistry, the advancement of knowledge in furan chemistry declined gradually as coaltar chemistry gained importance; then it was revived about 1925 when the industrial production of furfural provided raw material and incentive for renewed investigation. The cycle of interest is understandable to furan chemists, some of whom say jocularly that "a 40-percent yield from furans is equivalent to 100 percent in benzene chemistry." Behind this platitude is the fact that the manipulative art is paramount in furan chemistry. In these circumstances a comprehensive monograph such as the one under review becomes a necessity. It is fitting that it should have been compiled by representatives of the company that pioneered in production of furfural.

In addition to a preface by the authors, in which they wisely exclude lactones and anhydrides comprising 5-membered oxygen heterocycles, there is a short foreword by Brownlee and Miner who early realized the value of a naturally-generated chemical raw material, furfural, and who pioneered in its production. There is also a general introduction by the editors of the A.C.S. monograph series in which the curious and somewhat questionable statement is made that, "most workers in the sciences were coming to see the artificiality of the separation (between so-called 'pure science' publications and technologic or applied science literature)." Fortunately, Dunlop and Peters have realized the distinction, and the monograph is divided into Part I (707 pages, The Chemistry of the Furans), and Part II (76 pages, Industrial Applications of Furfural and its Derivatives).

The first 14 chapters of Part I cover the functional group derivatives of furan. The last two chapters of this part involve the important reactions of furan ring cleavage and catalytic hydrogenation. These chapters are excellently written with complete literature reference, adequate graphic formulation, and convenient tabulation. I regret that a short chapter describing furan syntheses from noncyclic substances was not included. Undoubtedly such an effort would have included the important syntheses of Morel and Verkade [*Rec. trav. chim.* 67, 539 (1948)], as well as alkyl furans, which are not mentioned.

Part II includes three chapters describing furfural as a chemical intermediate, as a solvent and, together with furfuryl alcohol, as a resin component. Since the authors state in their preface that only well-recognized industrial processes are included, Part II must necessarily be incomplete. An appendix summarizes the furan resin patents.

The typography is good and free from errors. Unfortunately, there is no author index, and the classification in the subject index is not uniform; but these deficiencies are minor. The monograph is highly recommended.

GEORGE F WRIGHT
Department of Chemistry, University of Toronto

New Books

Proceedings of a Conference on the Utilization of Scientific and Professional Manpower. Held Oct. 7–11, 1953, Columbia University. National Manpower Council, Columbia Univ. Press, New York, 1954. xii + 197 pp. $3.50.

Elementary Fluid Mechanics. ed. 3. John K. Vennard. Wiley, New York; Chapman & Hall, London, 1954. xii + 401 pp. Illus. $5.50.

Living Crafts. G. Bernard Hughes. Philosophical Library, New York, 1954. 192 pp. Illus. + plates. $4.75.

Plant Breeding for Everyone. John Y. Beaty. Charles T. Branford, Boston, 1954. 102 pp. Illus. + plates. $2.75.

Problems of Consciousness. Trans. of the Fourth Conference, Mar. 29–31, 1953. Harold A. Abramson, Ed. Josiah Macy, Jr. Fdn., New York, 1954. 177 pp. Illus. $3.25.

Plague. R. Pollitzer. World Health Organization, Geneva, 1954. (U. S. distr.: Columbia Univ. Press, New York.) 698 pp. Illus. + plates. $10.

A Thousand Geese. Peter Scott and James Fisher. Houghton Mifflin, Boston, 1954. 240 pp. Illus. + plates. $4.

Matter Energy Mechanics. Jakob Mandelker. Philosophical Library, New York, 1954. ix + 73 pp. Illus. $3.75.

Applied Electronics. ed. 2. Truman S. Gray. Technology Press, Cambridge, Mass.; Wiley, New York; Chapman & Hall, London, 1954. xxviii + 881 pp. Illus. $9.

Polymer Degradation Mechanisms. Proc. of NBS symposium, Sept. 24–26, 1951. National Bureau of Standards, Washington, 1953. (Order from Supt. of Documents, GPO, Washington, D.C.) iv + 280 pp. Illus. $2.25.

Instrumental Analysis. John H. Harley and Stephen E. Wiberley. Wiley, New York; Chapman & Hall, London, 1954. vii + 440 pp. Illus. $6.50.

The Collected Papers of Peter J. W. Debye. Interscience, New York–London, 1954. xxi + 700 pp. Illus. $9.50.

Insecticides and Colonial Agricultural Development. Proc. of 6th symposium of Colston Research Society, Mar. 23–27, 1953. T. Wallace and J. T. Martin, Eds. Butterworths, London, 1954. x + 169 pp. Illus. 30s.

The Physical Chemistry of the Silicates. Wilhelm Eitel. Univ. of Chicago Press, Chicago; Cambridge Univ. Press, London, 1954. xvii + 1592 pp. Illus. $30.

A French-English Dictionary for Chemists. ed. 2. Austin M. Patterson. Wiley, New York; Chapman & Hall, London, 1954. xiv + 476 pp. $6.50.

History of American Industrial Science. Courtney Robert Hall. Library Publ., New York, 1954. xix + 453 pp. $4.95.

The Chemical Structure of Proteins. Ciba Foundation Symposium. G. E. W. Wolstenholme and Margaret P. Cameron, Eds. Little, Brown, Boston, 1954. xii + 222 pp. Illus. + plates. $6.

New Green World. Josephine Herbst. Hastings House, New York, 1954. 272 pp. + plates. $4.

Methods of Biochemical Analysis. Vol. I. David Glick, Ed. Interscience, New York, 1954. x + 521 pp. Illus. $9.50.

Analytic Geometry. ed. 2. Edward S. Smith, Meyer Salkover, and Howard K. Justice. Wiley, New York; Chapman & Hall, London, 1954. xiii + 306 pp. Illus. $4.

Energy Metabolism and Nutrition. Raymond W. Swift and Cyrus E. French. Scarecrow Press, Washington, 1954. 264 pp. Illus. $5.75.

Methods in Medical Research. Vol. 6. J. Murray Steele, Ed. Year Book Publ., Chicago, 1954. xiii + 271 pp. Illus. $7.

The Dynamics of Virus and Rickettsial Infections. International symposium sponsored by the Henry Ford Hospital, Oct. 21–23, 1953. Frank W. Hartman, Frank L. Horsfall, Jr., and John G. Kidd, Eds. Blakiston, New York, 1954. xii + 461 pp. Illus. $7.50.

Chromium. A. H. Sully. Academic Press, New York; Butterworths, London, 1954. xii + 272 pp. Illus. $5.50.

Lower Tertiary Foraminifera of the Qatar Peninsula. Alan Hilder Smout. British Museum (Natural History), London, 1954. ix + 96 pp. Illus. + 15 plates. £2 5s.

Zirconium. G. L. Miller. Academic Press, New York; Butterworths, London, 1954. xviii + 382 pp. Illus. $7.50.

Tornadoes of the United States. Rev. ed. Snowden D. Flora. Univ. of Oklahoma Press, Norman, 1954. xvi + 221 pp. Illus. + plates. $3.50.

The Mating Instinct. Lorus J. and Margery J. Milne. Little, Brown, Boston, 1954. 243 pp. Illus. $4.50.

First Year College Physics. Clarence E. Bennett. Ronald Press, New York, 1954. vi + 526 pp. Illus. $6.

Of Whales and Men. R. B. Robertson. Knopf, New York, 1954. xii + 300 pp. Plates. $4.50.

Endogenous Endocrinotherapy Compendium. Ed. 4. Including the causal cure of cancer. Jules Samuels. N. V. Cycloscoop, Amsterdam, 1954. 600 pp. + plates. 37 guilders.

Copper. The science and technology of the metal, its alloys and compounds. Allison Butts, Ed. ACS Monogr. Ser., No. 122, William A. Hamor, Ed. Reinhold, New York, 1954. xii + 936 pp. Illus. $20.

Annuario Generale. Accademia Nazionale Dei XL, Rome, 1935. 536 pp. + index + plates.

Foundations of Potential Theory. Oliver Dimon Kellogg. Dover, New York, 1953 (Reprint of 1929 ed.). ix + 384 pp. Illus. Cloth, $3.95; paper, $1.90.

Scientific and Technical Papers. Seinen Yokota. Comp. and pub. by the Yokota Memorial Com., Univ. of Tokyo, 1954. xx + 398 pp. + 137 tables. Illus.

Compounds with Condensed Thiophene Rings. Howard B. Hartough and S. L. Meisel. Part of *The Chemistry of Heterocyclic Compounds* Ser., Arnold Weissberger, Ed. Interscience, New York–London, 1954. xv + 515 pp. Illus. Single copy, $16.50; subscription, $15.

Books Reviewed in THE SCIENTIFIC MONTHLY

July

Science, Medicine and History, E. Ashworth Underwood, Ed. (Oxford Univ. Press). Reviewed by Jane Oppenheimer.

Physical Chemistry, ed. 4, David Ingersoll Hitchcock (Little, Brown). Reviewed by Robert Livingston.

Planning Guide for Radiological Installations, Wendell Scott, Ed. (Year Book Publishers). Reviewed by Herbert C. Francis.

Biochemistry and Physiology of Nutrition, vols. I and II, Geoffrey H. Bourne and George W. Kidder, Eds. (Academic Press). Reviewed by Victor E. Levine.

Culture and Diseases of Game Fishes, H. S. Davis (Univ. of California Press). Reviewed by Kenneth D. Carlander.

Voices of the Night, Paul Peter Kellogg and Arthur A. Allen (Cornell Univ. Records). Reviewed by Karl P. Schmidt.

Westward Ho with the Albatross, Hans Petterson (Dutton). Reviewed by Dennis Puleston.

Evolution: Die Geschichte ihrer Probleme und Erkenntnisse, Walter Zimmerman (Karl Alber). Reviewed by Ernst Mayr.

Life of the Past: An Introduction to Paleontology, George Gaylord Simpson (Yale Univ. Press). Reviewed by William L. Straus, Jr.

Soil and Fertilizer Phosphorus in Crop Nutrition, W. H. Pierre and A. G. Norman, Eds. (Academic Press). Reviewed by T. F. Buehrer.

Vegetation and Watershed Management, Edward A. Colman (Ronald Press). Reviewed by Bernard Frank.

Wild Flowers of America, H. W. Rickett, Ed. (Crown). ***Wild Flowers of Western Pennsylvania and the Upper Ohio Basin,*** vols. I and II, O. E. Jennings (Univ. of Pittsburgh Press). Reviewed by Edgar Anderson.

Thomas Jefferson's Farm Book, Edwin Morris Betts, Ed. (Princeton Univ. Press). Reviewed by Carl Bridenbaugh.

Glacier Variations and Climatic Fluctuations, H. W: Son. Ahlmann (American Geographical Society). Reviewed by Richard Foster Flint.

Science in Alaska, 1951. Reviewed by Joseph T. Flakne.

Astronomical Photoelectric Photometry, F. B. Wood, Ed. (American Association for the Advancement of Science). Reviewed by Horace W. Babcock.

The Comets and Their Origin, R. A. Lyttleton (Cambridge Univ. Press). Reviewed by Glen H. Draper.

Space Travel, Kenneth W. Gatland and Anthony M. Kunesch (Philosophical Library) Reviewed by Herbert B. Nichols.

Semimicro Qualitative Analysis, rev. ed., Hervey Hubbard Barber and T. Ivan Taylor (Harper). Reviewed by Lloyd E. Malm.

Mathematics in Western Culture, Morris Kline (Oxford Univ. Press). Reviewed by Gaylord M. Merriman.

Miscellaneous Publications

Parental Age and Characteristics of the Offspring. Annals, vol. 57, art. 5. L. C. Strong *et al.* 163 pp. Illus. $3.50. ***Basic Odor Research Correlation.*** vol. 58, art. 2. Albert R. Behnke *et al.* 247 pp. Illus. $3.50. ***Mathematical Deductions from Empirical Relations between Metabolism, Surface Area, and Weight.*** vol. 56, art. 7. Hermann Von Schelling. 22 pp. Illus. $1. N.Y. Acad. of Sciences, New York 21, 1954.

Reach for the Sky (Chapter 20). Paul Brickhill. W. W. Norton & Co., New York, 1954. 13 pp.

Report on the Astrophysical Observatory, 1953 (From the Smithsonian Report for 1953). Leonard Carmichael. 5 pp. ***Insect Metamorphosis.*** Smithsonian M'sc. Coll., vol. 122, No. 9. R. E. Snodgrass. 124 pp. Illus. ***Two Silicified Carboniferous Trilobites from West Texas.*** vol. 122, No. 10. Harry B. Whittington. 16 pp. Illus.+ plates. ***A Revision of the Sea-Stars of the Genus*** **Tethyaster.** vol. 122, No. 11. Ailsa M. Clark and Austin H. Clark. 27 pp. Illus.+plates. ***Washington, D.C., Precipitation of 1953 and 1954.*** vol. 122, No. 13. C. G. Abbot. 4 pp. Illus. ***Songs and Stories of the Ch'uan Miao.*** vol. 123, No. 1. David Crockett Graham. 336 pp. Illus.+plates. ***Studies in the Bromeliaceae, XVII.*** Contr. U.S. Natl. Herbarium, vol. 29, Pt. 11. Lyman B. Smith. 23 pp. Illus. 20¢. Smithsonian Institution, Washington 25, 1954.

Composition of Cane Juice and Cane Final Molasses. Ser. No. 15. Wendell W. Binkley and Melville L. Wolfrom. Sugar Res. Foundation, New York, 1953. 24 pp.

Bollworm and Tobacco Budworm as Cotton Pests in Louisiana and Arkansas. La. Tech. Bull. No. 482. James R. Brazzel *et al.* La. Agricultural Expt. Station and Ark. Agricultural Expt. Station, Fayetteville, Ark., 1953. 47 pp. Illus.

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Proceedings of the Symposium on the Biochemical and Structural Basis of Morphogenesis. Utrecht, 27–29 Aug. 1952. E. J. Brill, Leiden, Netherlands, 1953. 176 pp. Illus.

East African Medical Survey Annual Report 1952. No. 4. 107 pp. ***Filariasis Research Annual Report 1952.*** No. 4. 39 pp. East Africa High Commission, Nairobi, 1953.

Proceedings of the First Japan National Congress for Applied Mechanics, 1951. 1952. 650 pp. Illus. ***Proceedings of the Second Japan National Congress for Applied Mechanics, 1952.*** 1953. 377 pp. Illus. Japan Natl. Committee for Theoretical and Applied Mechanics, Tokyo.

Report on Cetacea Stranded on the British Coasts from 1930 to 1947. No. 13. F. C. Fraser. 48 pp. Illus. 12s. 6d. ***The Pelagic Tunicata.*** John Murray expedition 1933–34. vol. X, No. 1. R. B. Seymour Sewell. 90 pp. Illus.+plate. £1. ***Notes on Podostemaceae for the Revision of the Flora of West Tropical Africa.*** Botany, vol. I, No. 3. G. Taylor. 28 pp. Illus. 10s. ***Carbonatites of the Chilwa Series of Southern Nyasaland.*** Mineralogy, vol. I, No. 4. W. Campbell Smith. 25 pp. Illus.+plate. 8s. British Museum (Natural History), London, 1953.

Careers in Photography. C. B. Neblette. Rochester Inst. of Technology, Rochester, N.Y., 1954. 28 pp. Illus. Free.

Bibliographie des Articles Parus dans Les Periodiques Turcs (In Turkish and French). L'Institut National Turc de Bibliographie, Istanbul, 1952. 138 pp.

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Trends in Economic Activity and Transportation in San Francisco Bay Area, pt. 5 of *Parking as a Factor in Business.* David A. Revzan. 1953. 160 pp. Illus. $2.10. ***Engineering Applications of Soil Surveying and Mapping.*** Highway Res. Bd. Bull. 83. 1953. 73 pp. Illus. $1.05. ***Experiments in Extension Programs for County Highway Engineers.*** Highway Res. Bd. Bull. 85. 1953. 15 pp. Illus. 30¢. ***Culvert Hydraulics.*** Highway Res. Bd. Res. Rpt. 15-B. 1953. 71 pp. Illus. $1.05. ***Automobile Parking in the U.S.*** Highway Res. Bd. Bibliog. 14. 1953. 119 pp. $1.35. ***Mechanization of Roadside Operations.*** Highway Res. Bd. Spec. Rpt. 16. 37 pp. Illus. 60¢. 1953. ***The Washo Road Test,*** Pt. 1. Design, construction, and testing procedures. Highway Res. Bd. Spec. Rpt. 18. 1954. 121 pp. Illus. $2.25. Natl. Acad. of Sciences–Natl. Res. Council, Washington 25.

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Discrete Sources of Extra-terrestrial Radio Noise. Spec. Rpt. No. 3. International Scientific Radio Union, Brussels, Belgium, 1954. 56 pp. Illus. $1.50.

Poliomyelitis Current Literature. A periodical annotated list. vol. 8, No. 2. 19 pp. ***Poliomyelitis Current Literature.*** vol. 8, No. 3. 20 pp. Natl. Foundation for Infantile Paralysis, New York, 1954.

Program of African Studies (The first five years, 1949–1953). Northwestern Univ., Evanston, Ill. 31 pp.

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Technical Papers

The Effects of Trace Amounts of Diethylstilbestrol in Rations of Fattening Steers*

Wise Burroughs, C. C. Culbertson, Joseph Kastelic, Edmund Cheng, and W. H. Hale

Iowa Agricultural Experiment Station, Ames

Diethylstilbestrol in trace amounts was placed in the feed of fattening steers in three Iowa feeding experiments. Feeding small amounts of diethylstilbestrol was associated with significant increases in liveweight gains and lower feed requirements per unit of gain in each of these experiments.

In the first experiment, three groups of 8 yearling steers each were fed similar fattening rations containing several levels of diethylstilbestrol. During a 46-day feeding period, these additions supplied none, 5 mg, and 10 mg of diethylstilbestrol per steer daily to each of the respective groups.

In the second experiment, four groups of 8 steers each, individually weighing about 700 lb, were fed the following ration for 84 days: corn *ad libitum*, 12 lb silage, 2 lb hay, and 2 lb soybean-oil meal per steer daily. Diethylstilbestrol was added to the soybean-oil meal to provide each steer in the respective groups the following levels: none, 2.5 mg, 5 mg, and 10 mg.

In the third and final experiment, two groups of 8 steers each, averaging initially 775 lb, were full-fed for 84 days a mixture of approximately 65 percent ground shelled corn and 35 percent ground corncobs. Group 1 in this experiment received a simple protein supplement (3 lb per steer daily) consisting of soybean-oil meal with no diethylstilbestrol added. Group 2 received a complex supplement in an amount equal to that fed to group 1 but containing sufficient diethylstilbestrol to supply 5 mg daily per steer.

The results of these experiments are presented in Table 1. The gain data were subjected to analysis of variance in which the total variation was partitioned into three fractions: outcome groups, diethylstilbestrol level effects, and residual error. In all three experiments, the differences in gain among rations were significant at the 5-percent probability level or less. In experiment II, there was a significant linear regression. Quite apart from the internal estimates of the standard errors given in Table 1, the reliability of the conclusions is indicated by the degree of agreement between the individual experiments.

Within each experiment, the data show that incorporation of trace amounts of diethylstilbestrol in the ration of fattening steers markedly increased weight gains when compared with animals not receiving diethylstilbestrol. In every case, steers receiving diethylstilbestrol required less feed per unit of gain than comparable steers not fed this material.

Table 1. Effects of diethylstilbestrol in the rations of fattening steers.

	Diethylstilbestrol per steer daily (mg)				
	0	2.5	5.0	10.0	Standard error of each mean*
Expt. I (36 days)					
Mean daily gain (lb)	2.12		2.84	2.50	±.14
Feed required per 100-lb gain (lb)	1144		929	1065	
Expt. II (84 days)					
Mean daily gain (lb)	2.50	2.71	3.15	3.41	±.16
Feed required per 100-lb gain (lb)	1157	1076	997	915	
Expt. III (84 days)					
Mean daily gain (lb)	2.51		3.15		±.06
Feed required per 100-lb gain (lb)	914		828		

* Each standard error applies to each mean daily gain in the respective experiments.

The steers in experiment I produced carcasses that were graded U.S. high-choice to low-prime. The carcasses produced by the most rapidly gaining animals (fed diethylstilbestrol) possessed quality characteristics similar to those found in carcasses from the control group as determined by grade characteristics and the yield of lean and fat from the 9–10–11 rib sections.

It has been observed previously (*1*) that diethylstilbestrol pellets placed as subcutaneous implants in fattening cattle result in more rapid and efficient liveweight gains. Despite the fact that the advantages of diethylstilbestrol implantations have been known for some time, this method of pellet administration has not been widely practiced by cattle feeders. There are several reasons for this: (i) A potential human health hazard is involved if substantial pellet residues remain in the tissues of treated cattle at time of slaugh-

* Journal Paper No. J-2451 of the Iowa Agricultural Experiment Station, Ames, Iowa. Project No. 1208.

ter. (ii) Diethylstilbestrol-pellet implantation during the fattening period appears to influence adversely carcass quality. (iii) Implanted animals may exhibit undue restlessness or abnormal sexual activity, such as "mounting." (iv) Some animals may exhibit toxicity symptoms from pellets.

The results obtained in the current experiments indicate that oral administration of diethylstilbestrol produces the desirable effects of pellet implantation without any of the undesirable side effects. The ease with which this material can be supplied to cattle by incorporating it in their feed is an important advantage. Also, the material can be easily removed from the rations of cattle should errors be made in amounts administered, or other unforeseeable situations develop. Still another advantage of the oral method of administering diethylstilbestrol is the ease with which a constant daily intake of an extremely small amount can be supplied to cattle over a feeding period of any given length of time. In contrast to this last advantage, when diethylstilbestrol is implanted as a pellet, the rate of release of the active material cannot be adequately controlled, and thus it may be released too rapidly initially and too slowly in the latter part of the feeding period for best results.

In conclusion, the placing of trace amounts of diethylstilbestrol in the feed of fattening steers increased live-weight gains as much as 35 percent over control animals not receiving diethylstilbestrol and reduced feed costs per unit of gain as much as 20 percent. No reduction in the fatness of the cattle or in the quality of the meat produced was noted when the diethylstilbestrol was incorporated in the steer feeds.

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January 28, 1954.

A Note on a Chemographic Artifact in Autoradiography

L. E. Preuss and C. Harrison

Edsel B. Ford Institute for Medical Research
Detroit, Michigan

Boyd and Board (*1*) have defined the histochemograph as a gross image or grain grouping produced by chemical action when a specimen is in contact with the emulsion (*2*). Fitzgerald *et al.* (*3*) apply the term *pseudophotographic* to agents, other than radiation, that will reduce the photographic emulsion. Such artifacts have been found superimposed upon autoradiographs of Cr^{51} and Au^{198} plaques.

These chemographs corresponded to the debris dusted on the emulsion from a conventional lead pencil that was used to mark the emulsion near the autoradiograph. They were first observed on medium lantern slide emulsion that was used for the production of gross autoradiographs of very thin metallic films

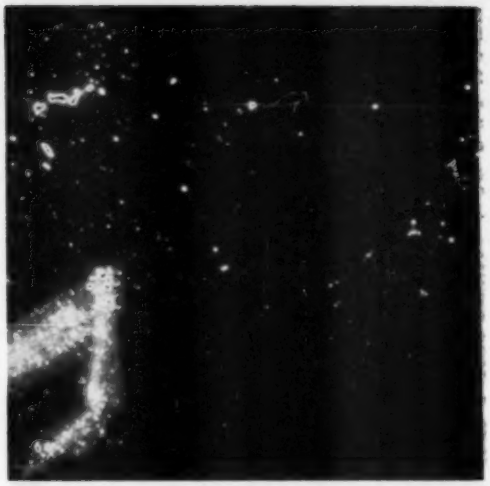

Fig. 1*a*. Appearance in dark field, showing the dispersion of the chemographic agent from the pencil mark at the left. Note the typical "halo" effect of the chemographs superimposed on the pencil mark.

of Cr^{51}, which was exposed for 1 mo at room temperature and developed in D-72 at 20°C for 3.5 min. The area on which the pencil-chemographs appeared was not submitted to pressure during the exposure. The

Fig. 1*b*. View in bright field at ×30, clearly demonstrating the absence of developed grains in the central area. The silver grain is represented here as a black region.

pencil marking was the source of the contaminant and fine debris was occasionally observed to sift from the mark. Grossly this chemograph is indistinguishable from an autoradiograph and, under magnification, resembles autoradiographs made by fine radioactive particulate material except for a characteristic nonreduced center area.

P. J. Fitzgerald has observed similar reduced areas apparently made by debris produced by the cutting of MLS plates (*4*). The pencil was of about 5B hardness

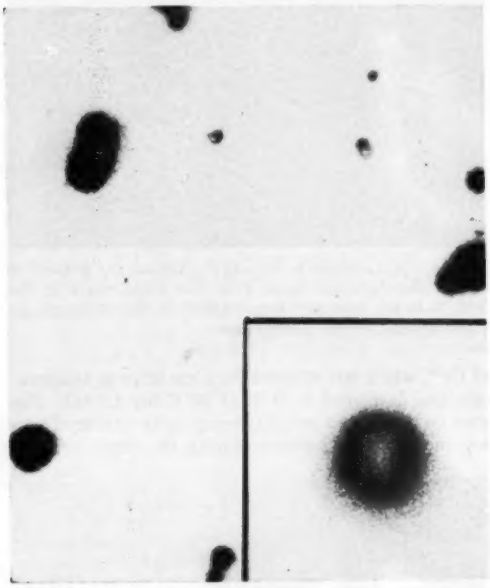

Fig. 2. A small group of chemographs at ×29 demonstrates the size distribution. The insert at ×50 shows the halo effect evident in one of the smaller grain groups. Both are in bright field.

and was of the type custom produced in quantity. However, the artifact was found with only one pencil type. Several pencil brands of different degrees of hardness were tested by varying exposure, development, and marking technique.

Figure 1*a* at ×2.7 in dark field presents the gross appearance of several areas rendered developable by debris from the pencil mark that is shown in part on the left. Figure 1*b* in bright field at ×30 shows striking examples of the clear central area. Figure 2 at ×29 gives the morphology and dispersion of grain groups with the desensitized central area less apparent; the insert, however, at ×50 shows that the "donut" configuration does exist in these chemographs. This structure correlates with the histochemographs of Boyd and Board from rat bone-marrow smears.

The artifacts described here are atypical of the usual pseudophotographic effects found by Fitzgerald. They are not superficial but extend through the emulsion and do not exactly circumscribe the source, but rather the grain concentration decreases with distance from the center. The clearness of the central area varies but suggests desensitization particularly in the larger chemographs where the effect is easily observed. The grain-grouping diameter ranged up to 1 mm, and the size of the artifact presumably was roughly related to the particle size of the reducing agent. The central desensitized area diameter was usually proportional to the total size of the "donut-like" artifact. Occasionally a "smear" of grains point back to the original mark showing the track of the reducing agent across the emulsion. These artifacts have been found up to 20 cm away from the pencil mark. The very fine particulate nature of the reducing agent allows for easy transport. Fitzgerald has also observed the rarer cell chemographs indistinguishable from the autoradiographs in which the grain concentration decreases with distance from the center (*4*).

In view of these findings, markings of autoradiographs with pencil should be discouraged, particularly where the gross apposition technique is employed and especially where the specimen is likely to incorporate fine particulate radioactive material, autographs of which may be confused with the pencil chemograph.

References

1. G. A. Boyd and F. A. Board, *Science* **110**, 586 (1949).
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3. P. J. Fitzgerald *et al.*, *Laboratory Investigation* **2**, No. 3 (May–June, 1953).
4. P. J. Fitzgerald, private communication.

January 26, 1954.

Sperm Storage at Lower-than-Body Temperature Outside the Body Cavity in Some Passerine Birds

Albert Wolfson

Department of Biological Sciences, Northwestern University, Evanston, Illinois

In most mammals the testes are located in the scrotum outside the body cavity. Moore has demonstrated conclusively the thermoregulatory function of the scrotum and its necessity for the production of mature germ cells (*1*). The temperature of the scrotum in common laboratory animals and in man is approximately 5° to 9° (F) lower than body temperature. In birds the testes are abdominal and the body temperatures are, in general, much higher than in mammals. In view of the need for a lower temperature for normal spermatogenesis in mammals, the condition in birds is of great interest.

During the course of our studies on the relation of photoperiod to the reproductive cycle, we noted an extensive development of the cloacal region at a specific time in the cycle. Further study of this cloacal protuberance showed that it was produced largely by the growth and coiling of the lower ends of the male ducts (*vasa deferentia*). Each enlargement was nodular in form. When fully developed the appearance of the two "nodules" on the posterior wall of the cloaca

Fig. 1. Cloacal protuberance in an adult male swamp sparrow (*Melospiza georgiana*). Anterior is toward the left and the bird is lying on its back. Note the outline of the "nodules" on the posterior wall and the relative displacement of the cloacal opening. The opening is not visible, but it is surrounded by the anal tuft of feathers; normally it is centrally located. Measurements of the protuberance were anterior wall, 6.2 mm; posterior wall, 6.7 mm; largest diameter, 7.0 mm. (Photographed June 23, 1952.)

was not unlike the testes in the scrotum of a mammal.

In Fig. 1, the distention of the posterior cloacal wall produced by the "nodules" is clearly illustrated. The "nodules" have been called seminal vesicles by most authors, but the term *glomera* (*glomus*, sing.) has also been used. In Fig. 2, the parts of the fully developed reproductive tract are shown. In the inactive state, the seminal vesicles are represented by a slightly coiled region of the *vas deferens* within the body cavity. Its width is slightly greater than that of the adjacent parts of the duct. Detailed observations of the protuberance and the seminal vesicles and their relation to the cycle of testis growth and to copulation have been presented (*2, 3*). These papers also contain a review of the literature and describe a method for obtaining sperm in the live bird. The purpose of this paper is to report on the temperature of the protuberance in relation to body temperature.

Measurements were made with a Leeds and Northrup single-range potentiometer calibrated to half-degrees Fahrenheit and employing an iron-constantan thermocouple. To measure the temperature of the protuberance, the bird was held on its back in the observer's hand; the thermocouple was inserted to below the middle of the protuberance (about ⅛ to ¼ in.) and held there. When the galvanometer needle stopped moving, which usually occurred in less than a minute, a reading was taken. The thermocouple was then inserted into the large intestine (about ½ in.) and another reading was taken. This temperature is referred to as the body temperature in Table 1.

In the absence of a protuberance, as in the inactive state or in the females, the thermocouple was inserted about ¼ in. In the females, the cloacal area is enlarged and swollen at the peak of the reproductive cycle, but it does not form a bulbous protuberance. In the laboratory, maximal development is reached only rarely. In the females in which there was some obvious enlargement of the cloaca, a second reading was taken with the thermocouple inserted into the large intestine.

The measurements on all birds were taken during the midday period, from approximately 11 A.M. to 5 P.M., under ordinary laboratory temperatures (70° to 80°F). In view of this, the handling of the birds, and the short time that elapsed before the initial reading was taken, the body temperatures are undoubtedly maximal temperatures (*4*).

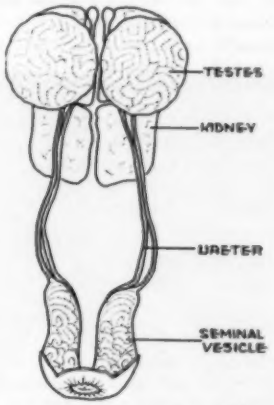

Fig. 2. Reproductive organs of a male slate-colored junco in breeding condition. Ventral view, diagrammatic, with protuberance pulled posteriorly. Weight of right seminal vesicle, 43.2 mg; left seminal vesicle, 40.4; both were 8 mm long, 3.5 mm wide, and 5.5 mm deep.

The birds in this study comprised four species that were being used in experiments on the effect of photoperiod on the reproductive cycle (see Table 1). The birds were captured during spring migration and subjected to highly stimulating photoperiods (20 hr/day), moderately stimulating periods (12 hr/day), and inhibitory periods (9 hr/day). Measurements were also made on birds retained under natural conditions of day length, which are highly stimulating.

The data are presented in Table 1. In each species, the birds are grouped first according to experimental treatment. This has been done to show the difference in the response of the accessory reproductive organs to the various photoperiod schedules. These responses are correlated with the response of the gonads. In each group, the birds are classified according to cloacal condition. The maximum condition is illustrated in Fig. 1. In the minimal state, there is hardly any elevation of the cloacal lips above the body wall. The term *moderate* indicates an intermediate state. No female reached the maximal state in these experiments. In some birds, regression of the reproductive

Table 1. Body and cloacal temperatures in some passerine birds.

No. of birds and sex	Date	Condition of cloaca	Temperature data (mean and range in °F)		
			Body	Cloaca	Difference
		Slate-colored junco (*Junco hyemalis*)			
		Group 1—Natural day length			
5♂♂	June 20	Maximum	109.4 (109.0–110.0)	101.6 (101.0–102.0)	7.8 (7.0–8.5)
4♀♀	June 20	Moderate	110.5 (110.0–111.0)	108.1 (107.0–109.0)	2.4 (1.5–3.0)
3♀♀	June 20	Minimum	110.1 (110.0–110.5)		
		Group 2—20-hr photoperiods per day beginning Apr. 17			
3♂♂	June 18	Maximum	109.3 (109.0–110.0)	102.8 (102.5–103.0)	6.5 (6.0–7.0)
2♀♀	June 18	Moderate	109.0 (108.0–110.0)	106.0 (105.0–107.0)	3.0
		Group 3—12-hr photoperiods per day beginning Apr. 16 and 17			
1♂	June 18	Submaxium	109.0	106.0	3.0
2♂♂	June 18	Moderate	110.7 (110.5–111.0)	107.7 (107.5–108.0)	3.0 (2.5–3.5)
2♂♂	June 18	Minimum	109.7 (109.5–110.0)		
2♀♀	June 18	Minimum	110.5 (110.0–111.0)		
		Group 4—20-hr photoperiods per day beginning Apr. 6			
2♂♂	June 22	Maximum	108.5 (108.0–109.0)	102.5 (101.5–103.5)	6.0 (5.5–6.5)
2♂♂	June 22	Regression (Mod.)	108.8 (108.0–109.5)	105.5	3.3 (2.5–4.0)
1♂	June 22	Regression (Min.)	109.0		
1♀	June 22	Minimum	111.0		
		Group 5—9-hr photoperiods per day beginning Apr. 25			
7♂♂	June 15	Minimum	108.0 (107.0–109.5)		
6♀♀	June 15	Minimum	109.1 (108.5–110.0)		
		White-throated sparrow (*Zonotrichia albicollis*)			
		Group 1—Natural day length			
3♂♂	June 20	Maximum	110.5 (109.0–112.0)	102.5 (101.5–104.0)	8.0 (7.0–9.0)
1♂	June 20	Regression (Submax.)	110.0	106.0	4.0
1♂	June 20	Regression (Mod.)	109.0		
		Group 2—20-hr photoperiods per day beginning May 15			
4♂♂	June 20	Maximum	110.9 (110.0–111.5)	104.1 (103.5–105.0)	6.8 (6.0–8.0)
		Group 3—12-hr photoperiods per day beginning May 15			
4♂♂	June 20	Maximum	111.9 (111.5–112.0)	104.3 (104.0–104.5)	7.6 (7.0–8.0)
2♂♂	June 20	Submaximum	110.5 (110.0–111.0)	105.0 (104.0–106.0)	5.5 (5.0–6.0)
2♀♀	June 20	Moderate	111.0	105.5 (105.0–106.0)	5.5 (5.0–6.0)
		Group 4—9-hr photoperiods per day beginning May 15			
4♂♂	June 20	Minimum	112.0 (111.5–112.5)		
		White-crowned sparrow (*Zonotrichia leucophrys*)			
		Group 1—20-hr photoperiods from May 31 to June 14; 12 hr, beginning June 14			
2♂♂	June 14	Maximum	107.0 (106.0–108.0)	99.5 (99.0–100.0)	7.5 (7.0–8.0)
2♂♂	June 18	Maximum	111.0	102.7 (102.5–103.0)	8.3 (8.0–8.5)
		Song sparrow (*Melospiza melodia*)			
		Group 1—Natural day length			
3♂♂	June 20	Maximum	110.5 (110.0–111.5)	103.3 (102.0–105.0)	7.2 (5.0–8.5)
1♂	June 20	Minimum	111.0		
1♀	June 20	Minimum	111.0		

organs had begun. This is indicated in the table along with the amount of regression that had occurred.

The mean body and cloacal temperatures and the range are given for each group. The results show clearly a marked difference in the temperatures of the protuberance and the body. The mean temperatures (°F) for the 10 juncos that had maximal cloacas were 109.2 (body temp.) and 102.1 (cloacal temp.); the mean difference was 7.05 with a range of 5.5 to 8.5. The mean temperatures (°F) for white-throated sparrows in similar conditions were 111.1 (body temp.) and 103.7 (cloacal temp.); the mean difference was 7.4 with a range of 6.0 to 9.0. In the white-crowned sparrows and song sparrows, the mean dif-

ferences were 7.5 and 7.2, respectively. Among the females and males with moderately developed cloacas, the temperature is lower than that of the body. The lack of development of the cloaca in the birds subjected to 9-hr photoperiods is readily observed, but it is interesting to have the added observation of essentially no change in the temperature of this region. The data on body temperature in each species agree closely with those of other authors (*5*, *6*).

The function of the seminal vesicles has not been clearly worked out. It is obvious that they store sperm, but it is likely that they have other functions. The epithelium is glandular (apocrine ?) and probably contributes to the somewhat viscous semen. The ejaculate appears to be a "pinpoint" of semen which is presumed to be placed directly in or near the opening of the oviduct (*7*). It seems possible that the sperm mature here in the seminal vesicles. Sperm obtained from the testes are not motile, while those obtained from the vesicles are. In the fowl, functional changes occur in the sperm as they pass through the male ducts, and functional maturity rarely occurs in the testis or epididymis (*8*).

If the main function of the seminal vesicles in these passerine birds proves to be maturation and maintenance of sperm, then it may be that these are temperature-sensitive functions. One of the functions of the protuberance, therefore, could be thermoregulation; another may be to facilitate intromission during copulation.

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February 2, 1954.

A Note on the Flagellation of *Phytophthora infestans* (Mont.) deBary

Virginia Rogers Ferris*

Department of Plant Pathology, Cornell University, Ithaca, New York

Examinations of swarmspores of *Phytophthora infestans* (Mont.) deBary with the phase-contrast microscope reveal paddle-like structures on the flagella. It was thought that further information concerning the structure of the flagella might be obtained from an examination of the swarmspores with the electron microscope. This paper is a preliminary report on the observations made with the electron microscope and an interpretation of the findings.

* National Science Foundation fellow. The author expresses her gratitude to Benjamin M. Siegel, Department of Engineering Physics, Cornell University, in whose laboratory the electron microscopy was carried out; and to Keith Williamson and Ramona Colwell for their help in preparing the electron micrographs.

Swarmspores were prepared for examination by a method similar to that used by Manton and her colleagues in their studies of the flagella of various organisms (*1*). A suspension of swarmspores in distilled water was prepared by incubation at 12°C of sporangia from a 10-day-old culture of the fungus. Droplets of the swarmspore suspension were placed on collodion-coated grids, and the grids were placed in contact with vapor from a 2-percent solution of osmic acid. After killing and fixation had occurred, the droplets were allowed to dry. Some of the preparations were shadowed with uranium before examination, and others were left unshadowed.

The electron micrographs show that one flagellum is ciliated and one is not (Fig. 1*b*). In pictures of shadowed preparations, it can be seen that the cilia of the ciliated flagellum are themselves terminated by still smaller projections (Fig. 1*a*). These findings are

Fig. 1. (*a*) Part of a ciliated flagellum (not that of *b*) showing cilia terminated by smaller projections. Electron micrograph, shadowed, ×14,000. (*b*) Swarmspore, showing part of each flagellum. Electron micrograph, shadowed, ×3500. (*c*) Enlargement showing tip of the nonciliated flagellum of (*b*) at the initial stage of rolling. Electron micrograph, shadowed. ×7000.

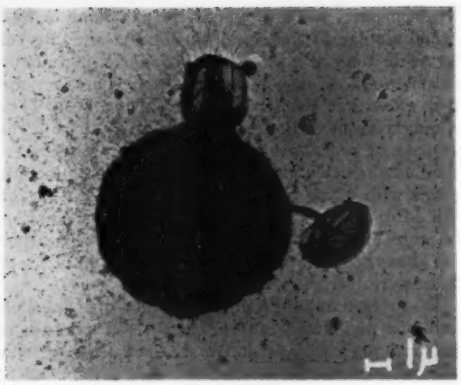

Fig. 2. Swarmspore with both flagella rolled inward from the tip. Electron micrograph, unshadowed, × 3500.

similar to those described from electron micrographs for the genus *Saprolegnia* by Manton *et al.* (*2*). Couch's (*3*) description of the flagellation of *Pythium* sp. based on staining procedures and observations with the optical microscope also fits closely the situation found in *P. infestans*.

The flagella of most of the swarmspores killed soon after their liberation from the sporangia and kept cold during the killing process are not paddle-shaped. The tip of the ciliated flagellum is slightly rounded, as is shown in Fig. 1*b*. The tip of the other flagellum often appears to be slightly tapered. In some preparations, however, a situation, such as that pictured in Fig. 1*c*, may be noted. Either one or both flagella appear to be rolled inward from the tip.

In droplets taken several hours after swarming, many swarmspores like that shown in Fig. 2 are seen. In these the flagella appear to have rolled up almost completely. Intermediate stages between those pictured in Figs. 1*c* and Fig. 2 also may be seen, and frequently a rolled-up flagellum is found detached from the body of the swarmspore. Occasionally all the stages can be found in the same droplet. In view of these findings, it seems likely that this is a way the swarmspore sheds its flagella preparatory to encystment and germination.

Further examination of living swarmspores with the phase microscope has confirmed this interpretation. Soon after swarming, the swarmspores are very active and will continue to be if they are kept cold. The flagella move rapidly and are difficult to see. However, they do not appear to be shaped like paddles at this time. As the water in the droplet begins to warm, the swarmspores begin to swim more slowly, and small paddle-like structures can be seen on some of them. The paddles soon become easier to see, partly because the paddle blades become larger, and partly because the swarmspores move more slowly. As the blade of the paddle enlarges, the handle separating it from the swarmspore body becomes shorter until often it cannot be seen. At this point, the swarmspore stops its movement. The flagella, still resembling paddles, become detached and float away.

These preliminary studies indicate that both time and temperature are factors in the formation of the paddles and their detachment. The flagellation of this organism is being studied further and will be described later in detail.

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January 28, 1954.

Effect of Isonicotinic Acid Hydrazide on Several Higher Plants*

D. J. Wort

Department of Botany,
University of British Columbia, Vancouver, Canada

Isonicotinic acid hydrazide (INAH) has been shown to be bacteriostatic *in vitro* in concentrations as low as 0.02 mg/ml (*1*), and it may possess some slight antifungal properties (*2*). Its effects upon the growth of higher plants and upon the enzyme chemistry of affected organisms have not been reported.

In three experiments conducted May–Oct. 1953, observations were made on vegetative, reproductive, and enzyme responses of bush beans, sugar beets, buckwheat, and spring oats treated with INAH. Each treatment, applied 21 days after sowing the seed, involved five pots of three to five plants.

The treatments were as follows: (i) aerial parts sprayed until wet with 0.1 percent Tween aqueous solutions of 0.1, 0.2, 0.4, 0.8, 1.2, or 1.6 percent INAH; (ii) one leaf immersed for 30 sec in the aforementioned solutions; (iii) one leaf, the upper epidermis of which had been removed by scraping with a sharp scalpel, immersed in 0.4, 0.8, 1.2, or 1.6 percent solutions; (iv) 50 ml of 0.4, 1.2, or 1.6 percent

Table 1. Green weights (grams per plant) of bean plant tops treated with isonicotinic acid hydrazide and harvested 51 days after treatment.

Concentration of INAH (%)	Aerial parts sprayed (g)	One leaf immersed (g)	One leaf abraded and immersed (g)	50 ml of solution on soil in pot (g)
0.4	41.9	43.6	40.7	42.4
.8	42.3	39.6	32.5	34.9
1.2	32.3	39.3	38.9	15.3
1.6	26.5	22.3	22.9	Dead

Untreated plants: 52.8 g.

* Supported by the Research Fund, University of British Columbia.

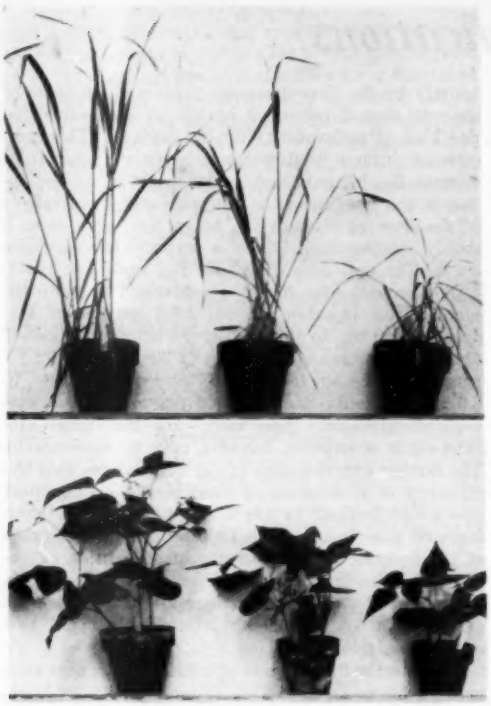

Fig. 1. Effect of 1.2 percent isonicotinic acid hydrazide solution on Victory oats (top) and Masterpiece bush bean (bottom) 24 days after treatment. From left to right: control, spray, and applied to soil.

solution of INAH applied to the soil in each 5½-in. pot.

Concentrations of 0.1 percent and 0.2 percent INAH had no visible effect on any of the plants. Solutions of 0.4 percent and higher resulted in a stunting of all plants irrespective of the method of application. The intensity of action increased with concentration of INAH. Buckwheat was most sensitive to treatment, followed by sugar beet, bush beans, and spring oats. Spraying or immersion of whole or abraded leaves did not result in absorption of sufficient INAH to cause the death of any plant, with the exception of buckwheat. Solutions of 1.2 percent and 1.6 percent, entering through abraded leaves, proved lethal to this plant. A solution of 1.6 percent INAH applied to the soil resulted in the death of all species. Buckwheat was killed by the soil application of 0.8, 1.2, and 1.6 percent INAH. Green weights of bean plant tops (Table 1) indicate growth response. This is also shown in Fig. 1.

Retardation of growth was evident 4 days after treatment. The stems of plants given a lethal dose drooped and the leaves curled and wilted within this time. These symptoms were followed by death of stem tips and necrosis of the stem just above the soil. Flowering was retarded from 3 to 7 days by the higher concentrations, but in no case where the plants survived treatment did flowering fail to occur. Photosynthesis, as indicated by the I-KI test for starch, was very considerably reduced in bean plants whose cut stems were immersed in 1.2 percent and 1.6 percent solutions of INAH. The production of adventitious roots on these stems was similarly affected. Lower concentrations had little effect on these two phenomena.

Table 2. Activity of catalase and phosphatase in oats, sugar beets, and beans not treated and treated with 1.2 percent isonicotinic acid hydrazide.

Plant	INAH	Catalase K_o	Phosphatase*
Oat	None	0.0447	76.7
	1.2% to soil	.0394	74.1
Bean	None	.0520	85.8
	1.2% to soil	.0403	81.6
Sugar beet	None	.0304	219.7
	1.2% spray	.0178	211.9

* Micrograms phenol.

Catalase activity was less in treated plants than in controls. The reduction was 42 percent in the case of sugar beets. Phosphatase activity was not significantly altered (Table 2). Enzyme activity was determined by methods given by Wort (*3*).

The effects of INAH are unlike those produced by maleic hydrazide (MH) in several respects. The inhibition of growth was not temporary; flower and vegetative buds were not completely inhibited; flowering was not delayed by the lower concentrations of INAH used; there was no local accumulation of anthocyanins; and there were no leaf and bud abscissions as have been obtained with MH (*4*). Moreover, INAH effects were more severe with the dicots used than with the monocot. The very considerable drop in photosynthesis and in catalase activity in the treated plants suggests that observable INAH effects stem in part from a lack of available photosynthate for cell material synthesis and available energy and in part from an inhibition of respiratory enzymatic action. Respiratory and phosphorylase studies are being continued.

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March 22, 1954.

Communications

Big Business Takes Over Research

Recent years have witnessed the establishment of large and powerful institutes, both governmental and private, for the prosecution of research in chemistry and physics. These institutes possess the financial backing, the equipment, the highly trained scientists and the technicians to follow up any new lead in science and to carry this lead rapidly to a successful conclusion. The journals are then flooded with research papers.

On the contrary, the scientific worker who happens to be a teacher in a college or university must prosecute his research with the help of untrained, or partly trained men and often has to put up with unsatisfactory or insufficient equipment. He is obliged also to divide his time between teaching and research. Thus it is patent that the teacher cannot compete successfully with members of research institutes.

It appears to me that college researchers are being forced into the background by this big business of research and that this situation is altogether undesirable. I fully agree with Curt P. Richter [*Science* **118**, 91 (1953)] who states that the man should be supported rather than the design and that we should educate public agencies and legislators to see the importance of backing individuals.

J. B. SUMNER

Cornell University, Ithaca, New York

April 7, 1954.

Intestinal Absorption of Vitamin B_{12} in Man

It is common knowledge that only a small part of vitamin B_{12} ingested is absorbed in the intestine (*1–6*). The underlying principles of intestinal absorption of this vitamin are, however, poorly understood. Recently, we have used surface scintillation measurements of the uptake of radioactive vitamin B_{12} by the liver following parenteral and oral administration of this vitamin for the study of intestinal absorption of vitamin B_{12} in human beings (*7*). We measured the hepatic uptake of radioactivity in normal individuals (*8–10*) following the ingestion of a standard dose of 0.2–0.4 μc (microcuries) of Co^{60}-containing radioactive vitamin B_{12}, to which variable doses of crystalline nonradioactive vitamin B_{12} were added. The mean hepatic counts obtained were then compared with those observed following intramuscular administration of a similar dose of the radioactive vitamin B_{12}. This allowed one to calculate the parenteral equivalent of the oral dose of vitamin B_{12} ingested.

It became evident from these studies that there exists an inverse relationship between the radioactivity counts over the liver and the amounts of crystalline vitamin B_{12} added to the radioactive vitamin B_{12} ingested. In the same individual, the uptake of radioactivity by the liver decreases rapidly on increase of the total dose of vitamin B_{12} taken in, when calculated per 1 μc of radioactive Co^{60}-B_{12} ingested. This indicates an inverse relationship between the amount of vitamin B_{12} ingested and the efficiency of its absorption in the intestine (*11*). The parenteral equivalents of the dose of vitamin B_{12} taken by mouth show a steady decline and follow a hyperbolic regression curve. The oral dose of 0.5 μg B_{12} results in radioactivity counts over the liver equivalent to those observed after injection of 90.5 ± 5.8 percent of this dose; of 1.0 μg, to those observed after injection of 81.5 ± 11.4 percent of this dose; of 2.0 μg, to 40.0 ± 8.1 percent; of 5.0 μg, to 22.0 ± 3.3 percent; of 20 μg, to 6.0 ± 1.5 percent; finally, of 50 μg, to 3.0 ± 0.7 percent of parenteral dose only. The individual differences in absorption, however, may be considerable. The farther extrapolation of the curve shows that the efficiency of absorption of vitamin B_{12} in the intestine would decrease to less than 1 percent if the dose ingested were increased to 1000 μg or more. Because of the decrease in the efficiency of absorption on increase of the intake, the increment in the absolute amount of B_{12} absorbed on increase of the dose ingested from 0.5 to 50.0 μg is strikingly small and amounts only to about 1 μg.

The intestinal absorption of vitamin B_{12} under normal conditions is controlled apparently by the existence of a *partial mucosal block* which shows much similarity to that regulating the absorption of iron in intestine. We believe that it may require for absorption of vitamin B_{12} in addition to Castle's gastric intrinsic factor also an intramural *"intestinal B_{12}-acceptor,"* the role of which in metabolism of B_{12} would be similar to that of apoferritin in iron absorption. With increasing saturation of B_{12}-acceptor in the intestinal wall, the absorption of vitamin B_{12} in the intestine would be braked, and this might explain the regression of efficiency of absorption of vitamin B_{12} on increase of the dose. After B_{12} passes into the blood through the intestinal membrane and before it becomes anchored in the liver and hematopoietic tissues, it circulates in the blood where it probably becomes bound to one of the proteins of the serum (*3, 12*), which by analogy with the serum transferrin we might call *"B_{12}-transferrin."*

The partial mucosal block to intestinal absorption of B_{12} changes to a complete or almost complete block in sprue and in pernicious anemia. This is evidenced by no, or a negligible, hepatic uptake of orally administered vitamin B_{12} in these diseases (*8–10*). In sprue, the block cannot be corrected by the addition of gastric intrinsic factor (*8–10*), because the defect in this disease depends on a generalized and inherent defect in the absorption mechanism of the intestinal wall. In pernicious anemia, the block to absorption of vitamin B_{12} depends largely on the absence of Castle's gastric intrinsic factor and can be converted into a

partial block similar to that existing in normals, by addition to vitamin B_{12} of normal human gastric juice (*1, 2, 13*), intrinsic factor concentrate from human or hog stomach (*14, 15*), or by lavishly increasing the intake of vitamin B_{12} (*2, 4*) alone. This, through mass effect, overcomes the block and results in the absorption of some fraction of the dose ingested. However, *the principle of regressing efficiency of B_{12} absorption in the intestine with increase of the intake* will still hold also under these circumstances (*16*).

GEORGE B. JERZY GLASS
LINN J. BOYD
LOUKIA STEPHANSON

Department of Medicine and
Gastroenterology Research Laboratory,
New York Medical College,
Flower and Fifth Avenue Hospitals, New York, N.Y.

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June 10, 1954.

Carbon Dioxide Compensation Point in Photosynthesis

Rabinowitch (*1*) has emphasized the scarcity of data concerning the "carbon dioxide compensation point" in photosynthesis (the CO_2 concentration which, with abundant light, yields zero values of apparent photosynthesis because photosynthesis just compensates respiration). He quotes values from three sources: Miller and Burr, for a large variety of potted plants, values of about 0.01 percent; Thomas, Hendricks, and Hill, for beet plants, 0.003 percent; Gabrielsen, for *Sambucus* leaves, 0.009 percent. Some additional values, computed from the literature, are presented here.

Table 4 of Heinicke and Hoffman (*2*) contains data from which the CO_2 compensation point can be estimated. In three experiments reported there (No. 9, 10, and 11) the leaf area per envelope was so large that apparent photosynthesis approached zero. Although they do not report the initial and final CO_2 concentrations of the air drawn through the envelopes, these values can be computed from their data. The computed values are presented in Table 1. Since the error in their CO_2 determinations seldom exceeded 0.005 mg/lit, the low value for CO_2 compensation point in No. 9 is significant, and its association with a low initial CO_2 content of air may be worth noting.

Table 1. CO_2 compensation point values computed from data of Heinicke and Hoffman.

Experiment	Initial CO_2 (mg/lit)	CO_2 compensation point (mg/lit)	(vol. %)
9	0.35	0.08	0.004
10	.59	.14	.007
11	.60	.14	.007

Figure 6 of Decker (*3*), if extrapolated to zero values of apparent photosynthesis, would provide estimates of the average CO_2 compensation points for the pines and hardwoods studied by him, but such extrapolation of Decker's data yields CO_2 compensation points of about 0.3 mg/lit (0.015 percent), which is 50 percent higher than the highest previous estimates. An examination of Decker's computations of mean CO_2 concentration, however, reveals an error. His plant chamber contained a fan that effectively stirred the air within the chamber, and photosynthesis determinations were made after steady-state conditions were obtained with a given rate of air flow. The CO_2 concentration around the plants, under such conditions, would be the same as that of the effluent air,

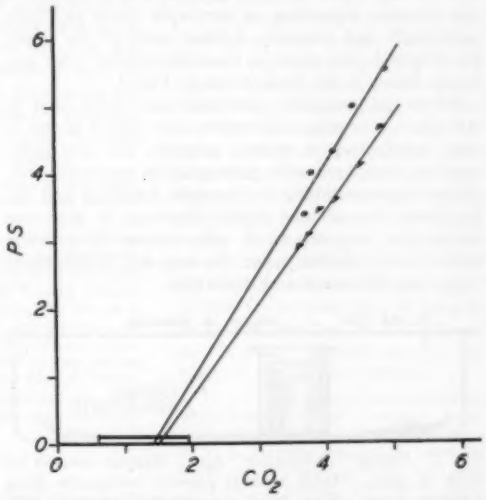

Fig. 1. Photosynthesis (relative values) vs. corrected values of CO_2 concentration (mg/lit, × 10), data of Decker. Each circle is the average of 10 determinations using loblolly pine. Each triangle is the average of 12 determinations combining data from dogwood, and tulip poplar. Extrapolation indicates a CO_2 compensation point of about 0.14 mg/lit (0.007 vol. percent).

not the mean of the values for affluent and effluent air, as Decker assumed.

If Decker's values for CO_2 concentration are corrected, the data appear as graphed in Fig. 1. Extrapolation of the lines shows a CO_2 compensation point of about 0.14 mg/lit (0.007 percent), thus agreeing closely with the values in No. 10 and 11 of Table 1. The initial CO_2 content of air in Decker's experiments averaged about 0.54 mg/lit. The bracket above the abscissa indicates the range of values for CO_2 compensation point appearing in the literature.

JACOB VERDUIN

F. T. Stone Institute of Hydrobiology
The Ohio State University, Put-in-Bay

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April 9, 1954.

Simple Method of Measuring Opaque Objects

Ozalid plan copying paper provides a simple, inexpensive method of measuring and recording dimensions and shapes of appropriate-sized nontransparent objects. No special equipment is needed other than concentrated ammonia and unexposed Ozalid paper.

An object to be measured is placed on unexposed paper and illuminated so that a sharp, dark shadow falls on the paper surface. After a few seconds to a few minutes, depending on the paper speed and light wavelength and intensity, lighted parts of the paper are bleached. The paper is then "developed" with ammonia fumes in the tank shown in Fig. 1.

Other light-sensitive materials have been used to reproduce true-scale silhouettes, but Ozalid paper is most satisfactory in several respects. Its slow light-reaction, compared with photographic materials, simplifies exposure-timing and permits handling and development in subdued light. However, it does not require the long exposures with intense illumination needed for blueprint paper. Its easy dry development minimizes shrinkage and distortion.

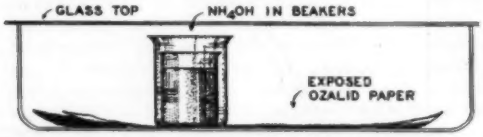
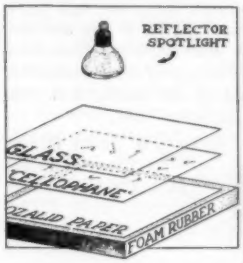


Fig. 1. Ozalid "developing" tank: dishpan covered by pane of glass. Double beakers prevent condensate from staining paper. With fresh concentrated ammonia (28 percent NH_3), latent shadow-image is developed in 5 min. Overdevelopment is impossible.

Versatility of direct-exposure methods using Ozalid paper is well illustrated by the widely different techniques that we used to solve the following specific problems.



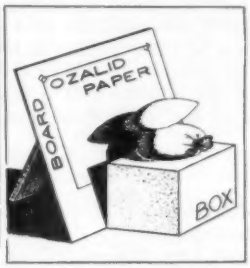


Fig. 2 (left). Expanded diagrammatic setup for silhouetting radish seedlings on Ozalid paper; 3 min exposure to No. 2 reflector photoflood lamp 5 ft above paper. Fig. 3 (right). Setup for silhouetting stream pothole "grinder" on Ozalid paper; 15 sec exposure to bright sunlight.

Schreiber's problem was to measure lengths of radish seedlings. (R. K. Schulz, Department of Soils, University of California, Berkeley, previously solved a similar problem by exposing seedlings on blueprint paper.) For each experiment, 45 seedlings had to be measured accurately and rapidly. In subdued light, seedlings were taken from soil, washed, and placed on waterproof cellophane over foam rubber (Fig. 2). Blotted, the seedlings were then weighted with a pane of glass to assure close contact and sharp shadows. Ozalid paper was inserted between the cellophane and foam rubber and was exposed. After development, the silhouettes were measured and filed for reference and comparison.

Higgins' problem was to make a scale cross-sectional drawing of a discus-shaped, 6-in. stream pothole "grinder." The drawing was traced from a sharp, life-sized Ozalid image obtained in the following manner. The grinder was placed on a sandbag (Fig. 3) so that the sun's shadow bisected the grinder and fell on a board placed perpendicular to the sun's rays. Ozalid paper, in a protective cardboard sandwich, was exposed to the shadow by removal of the upper cardboard for 15 sec.

These illustrations should suggest many possible applications of Ozalid direct-exposure methods to a great variety of problems involving measurements of opaque objects.

CHARLES G. HIGGINS
HENRY A. SCHREIBER

Department of Geological Sciences,
and *Department of Soils,*
University of California, Davis

April 30, 1954.

Kodak reports to laboratories on:

our sadness about a new reagent for ascorbic acid...the most sensitive lead sulfide photoconductive cell available...processing line copy of transitory interest

Vitamin C test

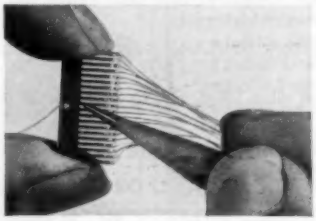
A new and apparently improved colorimetric assay method for ascorbic acid has been published recently and we're a little sad about it. Our sadness stems from the fact that the reagent widely favored hitherto for ascorbic acid has been the redox indicator *2,6-Dichloroindophenol Sodium Salt* (Eastman 3463). We know a trick that gives us a *2,6-Dichloroindophenol Sodium Salt* of which we are exceedingly proud. Now along come some people with an entirely different method, based on the enediol character of ascorbic acid rather than on its reducing proclivities. They claim that dehydroascorbic acid does not interfere in their test. (Reduce it to ascorbic acid with H_2S if you want it.) They further claim no interference from anything else likely to occur in finished pharmaceutical products, natural juices, or processed foods. They say sensitivity is 10 micrograms of ascorbic acid per ml. We have no reason to doubt them. They suspect the method works for biological fluids also and promise to look into that soon. Our only solace is the knowledge that the reagent for the *new* method is *4-Methoxy-2-nitroaniline* and that this too, in most satisfactory quality, has been in our catalog for many years as Eastman 2094.

The way to get a free abstract of the new procedure is to write Eastman Organic Chemicals Department, Distillation Products Industries, Rochester 3, N. Y. (Division of Eastman Kodak Company). You can even place your order at the same time for some 4-Methoxy-2-nitroaniline *if you're impatient to try it out. 25 grams for $1.50, 100 grams for $4.50.*

Ektron detectors

We are going to stop being coy about it and come right out and say that a certain manufacturer of materials for "chemical photography" whose name appears at the bottom of this page is now also manufacturing the most convenient device for the *electrical* detection of radiant energy.

It is called the *Kodak Ektron Detector*. It is the most sensitive lead sulfide photoconductive cell presently available. Its response to a 2500 K tungsten light source is about the same as that of a red-sensitive gas-filled phototube of comparable sensitive area under comparable conditions. But vibration doesn't bother it, for it consists merely of a prepared surface, operating right out in the open. Even more important, the sensitive surface can be of any size or shape. The 20 little black dots on this ¾-inch slip of glass, for example, are individual photoconductive cells.



So far you've read only half the story, possibly the less significant half. Though the *Kodak Ektron Detector* competes with the phototube and photomultiplier on their home grounds in the visible spectrum, it reaches its maximum sensitivity at 2μ in the infrared. At 2.7μ, operating at room temperature, it gives a hundred times the response of a good laboratory bolometer. All in all, the useful response extends from 0.3μ in the ultraviolet to 3.5μ in the infrared. Usable frequency response is from steady illumination to 5,000 radiation pulses per second.

This thing is more than a gleam in our eye. We are in production and can accept orders today. You transact your business with a man named W. F. Swann at Eastman Kodak Company, Rochester 4, N. Y. He can tell you about the various structural types of Kodak Ektron Detectors, *the many sizes and shapes in which we make them, and the story on matched sets and multiple-detector units. Figure from $14 to $24 apiece for the various standard* Kodak Ektron Detectors *you'll need for working out your ideas. We can talk later about quantity prices.*

No fix

Once upon a time there were some artists in England and on the Continent who thought it took too much time and too much art to do portraits and landscapes the old-fashioned way, so they invented photography. Later it was discovered that photography was not only a fine field for creative artistry but was also very handy for non-artistic tasks like recording oscillograph traces, avoiding tedious penmanship, or reducing a stupendous hardware price list to tidy little cards. Into this workaday world, photography has carried an atavistic preoccupation with permanence. Permanence, reasonably defined, is one of photography's most precious attributes, but where one doesn't really need it there's little point wasting a lot of time and water in its pursuit.

To this end, we draw your attention to a minor chemical invention called "stabilization." It takes the place of the traditional fixation and washing in processing line copy of transitory interest. "Stabilized" images on photographic paper can remain recognizable and legible for some time, but we make no intimations of immortality. The decision to "stabilize" is not an irrevocable death warrant for the image; if, before visible deterioration sets in, the decision turns out to have been rash, one may still fix and wash conventionally before committing it to the archives.

The general idea in stabilization is to convert the undeveloped silver halide into colorless silver complexes which remain in the print. With this may be combined the idea of "hot processing," so that one gives a sheet of photographic paper the works something like this: 1) develop in Kodak Developer PS-451 at 100 F for no more than 10 seconds; 2) squeegee; 3) whisk into Kodak Stop Bath PS-451 at 100 F for two seconds; 4) squeegee again; 5) hold for no more than 10 seconds in Kodak Stabilizer PS-451 warmed to 100 F; 6) squeegee for the last time; 7) dry between blotters.

To try this stabilization processing, write Eastman Kodak Company, Industrial Photographic Division, Rochester 4, N. Y., for more specific directions, the name of the nearest dealer who sells "PS-451" chemicals, and a little warning about the possibility of staining other papers or clothing by contact with stabilized prints. It would help if you told us what you propose to stabilize.

Prices quoted are subject to change without notice.

This is one of a series of reports on the many products and services with which the Eastman Kodak Company and its divisions are . . . *serving laboratories everywhere*

Kodak
TRADE-MARK

TRAVEL ARRANGEMENTS FOR THE AAAS BERKELEY MEETING

December 26-31, 1954

In time or in cost, a trip from an eastern city to California is not much more than a **round trip** to a midwestern city. Californians who for years have been attending meetings in the East have told their colleagues that the continental distance is the **same** each way, and that it should be the turn of the Easterners to visit the Pacific Coast.

The Association is planning ways it may assist those who will attend the 121st AAAS Meeting on the campus of the University of California at Berkeley, this December. The possibilities include:

1. Low cost AAAS limousines from Oakland and San Francisco airports and railroad terminals direct to the dormitory or hotel of each delegate.
2. Arrangements for traveling together in AAAS cars on fast trains leaving Chicago, Washington, D. C., and New York.
3. Arrangements for chartering first class DC6, 6B, or 7 planes of scheduled airlines—at prices comparable with air coach travel.

Note: In the following table of **round-trip** fares all figures include the new lowered 10% federal tax.

ROUND TRIPS TO OAKLAND OR SAN FRANCISCO FROM

	Chicago	Washington, D. C.	New York
By Bus	Time: 2½ days $82.50	Time: 4 days $104.94	Time: 4 days $112.31
By Rail	Time: 2½ days — leaving evening, Dec. 24 and morning, Dec. 31	Time: 3½ days — leaving evening, Dec. 23 and morning Dec. 31	Time: 3½ days — leaving evening, Dec. 23 and morning Dec. 31
Reclining seat coach	$ 99.17	$147.62	$156.64
First class	$139.10	$204.33	$222.67
Lower berth	46.20	60.06	63.58
Total	$185.30	$264.39	$286.25
By Air	Time: 7–8 hrs., leaving a.m. or p.m., Dec. 26; returning a.m. or p.m. Dec. 31	Time: 10–11 hrs., leaving a.m. or p.m., Dec. 26; returning a.m. or p.m., Dec. 31	Time: 10–11 hrs., leaving a.m. or p.m., Dec. 26; returning a.m. or p.m., Dec. 31
Air coach (no meals)	$167.20	$215.60	$217.80
Chartered 1st class (meals included)	c. $178.00	c. $235.00	c. $235.00
First class (meals included)	$239.91	$312.18	$332.09

PLEASE READ ABOVE TABLE, FILL OUT THIS COUPON, AND SEND IT TO

AAAS TRAVEL — Dr. R. L. Taylor
1515 Massachusetts Avenue, N.W.
Washington 5, D. C.

Name .....

Address .....

I shall probably attend the AAAS Meeting in Berkeley. Without obligation I am interested in possible group travel arrangements to San Francisco from:

1. ☐ Chicago ☐ Washington, D. C. ☐ New York ☐ Other city: .....
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   ☐ Rail — coach ☐ Air — coach ☐ Bus
   ☐ Rail — 1st class ☐ Air — chartered, 1st class ☐ Other
   ☐ Air — 1st class
3. I would
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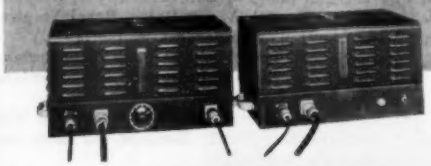

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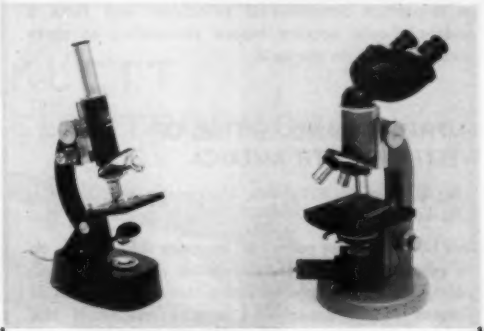

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12–14. International Cong. on Group Psychotherapy, 1st, Toronto, Can. (J. L. Moreno, 101 Park Ave., New York 17.)

13–14. International Cong. on Child Psychiatry, Toronto, Can. (A. Z. Barhash, 186 Clinton Ave., Newark 5, N.J.)

15–21. World Poultry Cong., 10th, Edinburgh, Scotland. (Cong. Sec., Dept. of Agriculture for Scotland, St. Andrew's House, Edinburgh 1.)

14–21. International Cong. on Mental Health, 5th, Toronto, Can. (J. D. Griffin, 111 St. George St., Toronto 6.)

15–28. Pan Indian Ocean Science Cong., Perth, Western Australia. (A. D. Ross, 31 Ventnor Ave., West Perth.)

16–18. American Malacological Union, Durham, N.H. (M. Teskey, 144 Harlem Ave., Buffalo 24.)

18. Stanford Conf. on Population Problems of Latin America, Stanford, Calif. (R. Hilton, Hispanic American Studies, Stanford Univ., Stanford.)

19–20. National Council of Geography Teachers, San Francisco, Calif. (Mrs. I. C. Robertson, State Teachers College, Valley City, N.D.)

19–31. International Conf. of Ship Hydrodynamics, 7th, Göteborg, Sweden. (H. F. Nordstrom, Statens Skeppsprovningsanstalt, Göteborg.)

20–26. American Pharmaceutical Assoc., Boston, Mass. (R. P. Fischelis, 2215 Constitution Ave., NW, Washington 7, D.C.)

23–26. American Veterinary Medical Assoc., annual, Seattle, Wash. (J. G. Hardenbergh, 600 S. Michigan Ave., Chicago 5, Ill.)

23–28. International Cong. for the Philosophy of Science, 2nd, Zurich, Switzerland. (Sec., Internationales Forum Zurich, Room 20d, Eidengenssische Hochschule, Zurich 6.)

23–28. International Cong. of Soil Science, 5th, Leopoldville, Belgian Congo. (F. A. van Baren, Royal Tropical Inst., Mauritskade 63, Amsterdam, Netherlands.)

23–28. International Photobiological Cong., Amsterdam, Netherlands. (Cong. Sec., Radiologische Laboratorium, Wilhelminagasthuis, Amsterdam.)

23–3. International Scientific Radio Union, 11th, The Hague, Netherlands. (I. E. Herbays, 42 Rue des Minimes, Brussels, Belgium.)

24–28. Potato Assoc. of America, Estes Park, Colo. (R. L. Hougas, Dept. of Genetics, Univ. of Wisconsin, Madison 6.)

25–27. American Phytopathological Soc., annual, Estes Park, Colo. (G. S. Pound, Dept. of Plant Pathology, Univ. of Wisconsin, Madison.)

25–27. Biological Photographic Assoc., 24th annual, Atlantic City, N.J. (A. F. Hancock, Photo Unit, Jefferson Hospital, 1020 Sansom St., Philadelphia 7.)

25–27. Western Electronics Show and Convention, Los Angeles, Calif. (M. Mobley, Jr., 344 N. LaBrea Ave., Los Angeles 36.)

27–28. Minnesota Acad. of Science, Itasca State Park, Minn. (B. O. Krogstad, Dept. of Biology, St. Olaf College, Northfield, Minn.)

28–29. Soc. for Social Responsibility in Science, annual, Yellow Springs, Ohio. (SSRS Office, Gambier, Ohio.)

30–1. American Soybean Assoc., 34th annual, Memphis, Tenn. (G. M. Strayer, ASA office, Hudson, Iowa.)

(See the June 18th issue for more comprehensive lists.)

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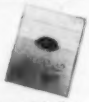

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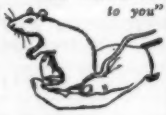

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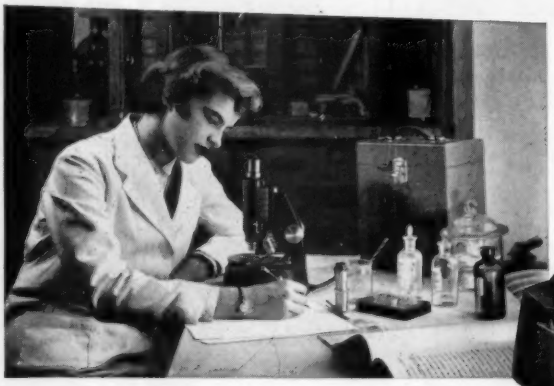

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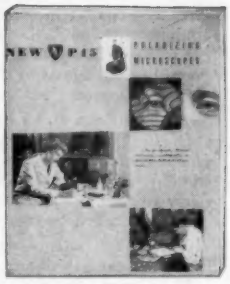

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